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MAY 1 1948

VOLUME LVIII

MARCH, 1948

NUMBER 3

THE LARYNGOSCOPE

FOUNDED IN 1896

BY

MAX A. GOLDSTEIN M.D.

PUBLISHED BY
THE LARYNGOSCOPE

640 SOUTH KINGSHIGHWAY

ST. LOUIS (10), MO., U. S. A.

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THE LARYNGOSCOPE.

VOL. LVIII

MARCH, 1948.

No. 3

A REVIEW OF THE AVAILABLE LITERATURE ON THE LARYNX AND LARYNGEAL SURGERY FOR 1947.

HENRY B. ORTON, M.D.,
Newark, N. J.

HISTORICAL.

1947 seemed to be a year of many centennial medical celebrations, and a number of papers have been written on the history of otolaryngology. Brown,¹ as Chairman of the Section on Otolaryngology, in his address, gave a historical review of this specialty. Fenton² gave a history of otolaryngology in the United States from 1847 to 1947. Furstenberg,³ in his paper, warns the otolaryngologist that he must be thoroughly trained in the principles of surgery, the newer surgical techniques, protein metabolism, the recognition and treatment of shock, the value of early ambulation methods of resuscitation therapy, and the use of modern anesthetics, if he is to practice surgery of the head and neck with credit to himself and safety to his patient. They are all worthwhile papers and should be read by all otolaryngologists and those interested in the history of medicine. The writers are to be commended for recalling to the few, and introducing to the many, the noble works of the men mentioned in their articles.

PHOTOGRAPHY OF THE LARYNX.

Color photography of the larynx is no longer in the experimental stage. It is a valuable adjunct to the recordings of clinical data, the presentation of cases and to visual teaching

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, March 1, 1948.

methods. In an extremely interesting and enlightening paper, Holinger⁴ presents a photographic record of some of the most common types of laryngeal pathology. The gross appearance of the larynx is shown as it is seen in the laryngeal mirror or through the direct laryngoscope. The authors begin with photographs of indirect views of the normal larynx, followed by the direct view of the landmarks visualized during the introduction of the laryngoscope. A very descriptive account of the camera, the laryngoscope and the technique used to obtain these photographs is given.

CYSTS OF THE FLOOR OF THE MOUTH, PHARYNX AND LARYNX.

In speaking of congenital cysts of the tongue, the floor of the mouth, the pharynx and the larynx, New⁵ mentions the congenital cysts that must be considered, as follows: ranula, dermoid cyst, cystic hygroma, aberrant thyroglossal cyst of the tongue or of the floor of the mouth, branchial cyst of the pharynx and laryngeal cyst.

Microscopically, cystic hygroma and lymphangioma cannot be distinguished, and they react identically to radium treatment. Formerly attempts were made to drain cystic hygroma by aspiration, but the cyst usually became infected, with disastrous results. Surgical removal is satisfactory; irradiation or radon seeds may also be used with good results.

The treatment in thyroglossal cyst is surgical in removing the cyst or cystic tract in the interval between infections. An incision is made in the skin of the neck below the hyoid bone and the cystic tract is dissected upwards to that part of the hyoid bone to which it is attached. The hyoid bone is divided on either side with the bone forceps and the intervening portion of bone is removed with the tract.

Congenital laryngeal cysts of the larynx may not produce symptoms until adult life, but may cause death once the larynx becomes obstructed by a mass present at the base of the epiglottis and side of the larynx.

The treatment of laryngeal cysts is usually by a lateral

thyrotomy which divides the thyroid cartilage and dissects the cyst out.

While congenital cyst of the larynx is rare, it should be removed by a lateral thyrotomy. Destruction of that part of the cyst which involves the inside of the larynx may entirely relieve the symptoms but may leave a cyst above and external to the thyroid cartilage, which may later cause some symptoms.

In speaking of branchial cysts, such a cyst extending into the pharynx is rare. A lateral extension of a congenital cyst of the larynx may be present in the hypopharynx at the base of the tongue; however, Adams⁶ states that textbooks and clinical experience describe the tract of a third and fourth branchial cleft as passing between the internal and external carotid artery, and ending on the deep aspect of the tonsil. Unfortunately, the decision not to proceed with the exposure of the tract in the neck raises an element of doubt as to whether the cyst removed was, in fact, the expanded upper end of the branchial cleft in a case of a branchial cleft appearing as a post-tonsillar abscess reported by the author, but no other explanation seems possible. If it is accepted as a branchial cleft, into the posterior pillar of the fauces and its complete freedom of attachment to any part of the tonsil capsule suggests that a hypothesis previously favored by the reporter, that the palatine tonsil is the lymphatic guard of the primitive opening of this branchial cleft, must remain doubtful.

CONTACT ULCER OF THE LARYNX.

That contact ulcer is a disease of the adult male is well known, and if vocal abuse alone were an important etiological factor, it is curious that the gentler sex has been so spared. Poor mouth hygiene, sinusitis, irritating atmosphere, infected tonsils and acute respiratory infection may be contributing factors. The plausible causative mechanism is that of the traumatic (hammer on anvil) effect as the arytenoids meet during phonation, and especially phonation that is harmful to the larynx.

Rosenberger⁷ states that the clinical picture is that of an ulcer on the posterior end of one or both vocal cords. The ulcerated area may be more or less covered with granulomatous protuberance. The ulcerated tip of the involved arytenoid cartilage may be visible. Cord movements may be normal unless the joint is involved by chondritis. The patients' complaints are hoarseness, tired voice, localized or referred discomfort and cough. The differential diagnosis lies between tuberculosis, luetic ulcer and malignancy. If benign tumors are present, they offer a little more difficulty than when a granuloma is present, and here a biopsy is helpful. In treatment, conservatism is urged, gentleness and the patient persistence in dealing with these contact ulcers of the larynx are recommended.

This conservatism and gentleness in the treatment of contact ulcer is further emphasized by Peacher,⁸ when she states that vocal abuse has been conceded by laryngologists to be the factor contributing most to contact ulcer. If this is true, vocal re-education should have an effect in the healing of the ulcer, and because of this the authors deemed it desirable to study the effect on contact ulcer of training in good vocal production. The re-education consisted of instruction to the patient in the correct use of the speaking voice, which is quite dissimilar to training of the singing voice. Although all factors were considered with each patient, individual adaptations were occasionally necessary.

In their conclusions, the authors state that it is absolutely necessary, therefore, that the patient with contact ulcer radically alter his method of phonation. The vocal abuse seemed to be the chief perpetuating factor in the patients treated, and the vocal re-education was apparently better than obtained by surgical excision of the ulcer, and silence.

NEURINOMA OF THE LARYNX.

Walker⁹ reports an additional case in the literature. The preoperative diagnosis of neurinoma is not definitely established. This may be due in part to the difficulty encountered

in attempts at biopsy. Suffice it to say, the terms neurinoma, neurofibroma and Schwannoma are generally considered to refer to identical growths. In all of the patients, chronic progressive hoarseness was the main complaint. Dyspnea was not a prominent symptom, but it was present to some degree when the tumor was large enough to become obstructive. There was no pain reported in any of the cases, but there was the feeling of discomfort.

The physical findings were those of a small tumor mass covered by an intact mucous membrane. In contrast, a malignant growth which has advanced to a size comparable to some of the neuronimas reported would probably cause pain and have ulceration.

In the author's case the mirror examination of the larynx revealed a large, smooth, reddish mass filling the right side of the larynx and extending well past the midline so that a definite airway was not visible. The right arytenoid was fixed. After a preliminary tracheotomy was done under local anesthesia, later under general anesthesia, a laryngofissure was performed. The growth was dissected free, leaving the true vocal cord on the right and all the mucous membranes below the cord intact. The area of removal was closed with catgut sutures. The larynx and the neck muscles were closed without drainage.

Neurinoma of the larynx is a rare condition. The diagnosis in all 16 cases reported has been made postoperatively from study of the microscopic sections. Paralysis of the affected side may be present before operation. Complete removal is the only therapy necessary and the prognosis is good.

ADENOMA OF THE TRACHEA.

Adenoma of the trachea is comparatively rare, as indicated by the few cases reported in the literature as well as by the personal experiences of several authorities working in large clinics.

Smith¹⁰ reports a case of adenoma of the trachea which was

successfully removed by the external surgical approach. Five years have elapsed since the removal of the tumor, and there is no evidence of any recurrence or metastasis at the present time. The author also states that in view of the time elapsed since operation, it would seem that this tumor might be classified as a benign tracheal adenoma.

STENOSIS OF THE LARYNX.

Martin¹¹ presents two cases of battle wounds involving the larynx and trachea, one of which resulted in a marked stenosis of the cords and subglottic area. The second case resulted in stenosis of the cords and almost complete obstruction of the trachea.

In the first case, it was found that the patient suffered severe laceration of the neck and compound comminuted fractures of the mandible and the hyoid bone. The interior of the larynx was exposed through a midline incision, and all scar tissue was removed. Then an acrylic stent was placed in the area and held by wires, according to the method described by Figi. This stent was retained about three weeks and was then removed by means of a string brought out through the patient's mouth at the time of operation.

The second case developed a web below the cords anteriorly, and there was a small opening about 3 mm. in diameter at the right anterior wall. The operative procedure on this case was that the trachea was opened from the tracheotomy tube to the level of the cricoid cartilage. A thin membrane was found just below the cricoid; this membrane was excised and a stent placed in the trachea. This stent was removed in three weeks.

BILATERAL ABDUCTOR PARALYSIS OF THE LARYNX.

Temporary complete paralysis of both recurrent laryngeal nerves due to an extension cast applied for scoliosis, is reported by Laszlo,¹² who presents a case where external pressure combined with a stretching of the neck caused the paralysis of both vocal cords. The author states that no simi-

lar case has been found in literature. It was necessary to perform a low tracheotomy for the relief of the dyspnea. He attributes the complete recovery of the patient to two facts: first, the timely removal of the cast relieved the nerve from the combined pressure and the stretching and gave it a chance to re-establish its function; second, while the pressure was uniform and of comparatively long standing, it was not localized on any special point on the nerve. It was also interesting to note that the lobar pneumonia developed in spite of the administration of large doses of penicillin and sulfadiazol but responded promptly to sulfadiazine.

Applied Surgery of the Larynx in Bilateral Abductor Paralysis: It seems proper and timely that Kelly,¹³ after a period of seven years, should again review the literature on this subject and attempt to standardize the different surgical procedures advocated, so that laryngologists contemplating this work will have some facts to guide them in determining which type of surgical relief is best suited to their particular requirements. Kelly goes on to describe various operations that have been devised for this condition. He sums up his conclusions with the statement that there are two definite surgical procedures which have been tried and not found wanting according to the statistics of successful results: there is the posterior approach of King and the second one, described as an arytenoidectomy, in which a direct approach is made to the arytenoid cartilage either through a window in the thyroid cartilage or posteriorly behind the thyroid cartilage, leaving the cartilage intact or removing a portion of it, as the operator so desires.

ACUTE INJURIES.

Acute injuries involving the large blood vessels in the neck occur infrequently, as brought out by Lichtenstein,¹⁴ who states that some of those who sustain injuries to the neck, involving large vessels, succumb immediately from exsanguination, strangulation or aspiration of blood into the pulmonary tree. Others die shortly after injury from cerebral changes

due to the progress of a thrombus or embolus, while still others die from concomitant injuries in the neck.

In addition to the common, external and internal carotid arteries, there are present in the neck branches of the subclavian, notably the vertebral artery and the thyrocervical axis with its several branches.

Proper exposure makes it necessary to control bleeding in the neck. The author reports six patients who sustained injuries to the common carotid artery alone or in conjunction with other vascular injuries in the neck; and three patients who sustained other significant vascular injuries to the neck, and the methods employed in the initial management of the cases recorded are described. The following general comments are warranted: that the vascular injuries in the neck are not common but are serious and may be fatal. Blood for replacement of that lost before or during surgery must be available, at hand and ready for use. Anesthesia must afford a high oxygen intake. Ligations of vessels should be done at sites free from trauma and adjacent to branches or tributaries to prevent thrombosis in the blind segment. It is noteworthy that in those patients who sustained wounds of the neck involving blood vessels, injury to the larynx, trachea, pharynx or esophagus, or both, were rare. In another series of cases in which injuries were sustained involving the larynx, pharynx or esophagus, or both, there were no large vessel injuries. Ligation of the carotid artery soon after trauma is usually not followed by mental, cerebral or peripheral changes in the age group noted in this series. It is obvious that occlusion of the common carotid or the internal carotid artery results in a marked diminution in the blood supply to the brain. It is difficult to explain, why in some patients this brain anemia is temporary and not destructive of the functions of the brain, while in others changes of great severity rapidly ensue. Many theories have been offered, but there is probably none which will satisfactorily explain the phenomenon in every case. Venous bleeding in the neck is best controlled by careful isolation of the damaged vessel, ligation of the bleeding point, or when necessary, suture of the bleeding

site. The rôle of the antibiotics played in the prevention or the control of infection in these patients was the same as in other patients with wounds elsewhere on the body.

Injuries involving the soft tissues, as the food and air passages, in the neck vary (as Lichtenstein¹⁵ brings out) in their extent and significance from the trivial, superficial and inconsequential to the most extensive, deep, disabling, life endangering and fatal. Tracheotomy may be necessary and urgently so when signs of obstruction are noted; however, in many instances of neck wounds with dyspnea, incision into the fascial spaces as part of the initial surgery of the wound was followed by relief from the signs and symptoms of obstruction. Anesthesia may be administered through the tracheotomy tube or through an endotracheal tube. Aspiration of the trachea and bronchi may be accomplished easily. He states that this is an important factor in the avoidance of pulmonary complications. For wounds of small magnitude, local anesthesia is useful. When contamination of the deep neck structures has occurred, because of perforation of the oral, pharyngeal or esophageal mucous membrane, incision into the fascial layers with exposure of the retropharyngeal space prevents edema and spread of infection into the mediastinum. The value of gastrostomy in certain wounds of the pharynx and esophagus should be appreciated and the operation done while the patient is in good condition, when tube feeding through the nose is not possible. Tracheal wounds when not too extensive to close or may be closed by suture of the overlying fascia, muscle or adjacent thyroid tissue. The skin wounds adjacent to openings in the food and air passages are left open until it is certain the wound is free from gross infection. The closure of the wound may be done after five days by suture or by positioning of the head and purposeful bandaging. Penicillin is used routinely and appears to be a factor in the avoidance of local and spreading infection.

Various papers have appeared on gunshot and shell fragment wounds of the neck with laryngeal involvement. Surgical management has been emphasized throughout. Although impairment of voice is not mentioned in every instance, it is

assumed that it was present in some patients because of the nature and extent of the injury. In this connection, speech disorders in the recent war have been emphasized by Peacher.¹⁶

In his statistics the incidence of traumatic dysphonia was low, in that only approximately about 1 per cent of all wounds necessitating hospitalization involved the neck.

Gunshot wounds of the cervical region may cause dysphonia by one or more of the following general mechanisms: first, direct trauma of the larynx; second, paralysis of the vagus or recurrent laryngeal nerve, and third, indirect injury of the afore-named structures with resulting temporary edema, hemorrhage, etc.

Under therapy in cases of traumatic dysphonia, the surgical procedures were divided into the immediate procedures, including debridement and tracheotomy and, later, reconstructive procedures. In addition, dilatation of laryngeal strictures, elective tracheotomy in cases in which the cannula has been inserted in the vicinity of the laryngeal cartilages during the exigencies of warfare. Laryngectomy might be indicated occasionally with severe avulsion injuries, also some type of an arytenoidectomy, and plastic repair of the larynx.

The article gives a very complete description of the various types of dysphonia that were observed in the speech clinics at some of the Army General Hospitals over a period of three years.

The increasing use of the endotracheal tube in anesthesia has been reported to be without serious sequelae. Tuft,¹⁷ reporting a case of laryngeal polypoid granuloma following intratracheal anesthesia, is again calling attention of the medical profession to the possibility of trauma to the larynx during intratracheal anesthesia and its possible serious complications.

The hoarseness developed about two months following an operation for gastrectomy in which an intratracheal anesthesia tube was used. Examination of the larynx at this time showed two large pedunculated granulomatous masses appar-

ently attached to the vocal processes and almost completely occluding the posterior half of the larynx. These findings were discovered under indirect laryngoscopy. The author states that there were five other cases reported in the literature and the majority of the cases reported showed that the lesion was located in the posterior portion of the larynx. He further states that in view of the possibility of this type of granuloma occurring after the use of an intratracheal anesthesia tube one should carefully investigate symptoms referable to the larynx after intratracheal anesthesia.

Barton¹⁸ reports two additional cases of granuloma of the larynx following intratracheal anesthesia. In both of these cases the pathological report of specimens removed was granulation tissue showing active inflammation. In each of these cases of granuloma reported by the author there was a history of an operation in which intratracheal anesthesia had been given a few months prior to the onset of the patient's present laryngeal complaint of hoarseness. It would seem that the granuloma had its origin in an ulcer which resulted from abrasion occurring in the passage of an intratracheal tube. From the location of the tumor, it appeared that it is most likely to form if the abrasion is on the posterior end of the vocal cord or on or near the vocal process of the arytenoid cartilage, where it is subject to trauma in the use of the voice.

This author also states that the larynx should be examined following endotracheal anesthesia and if any abrasions are seen the patient should be placed on voice rest and receive appropriate treatment. This should be followed with periodic examination until the lesion is healed.

LYMPHOGRANULOMA VENEREUM.

The clinical picture of lymphogranuloma venereum, according to Scheie,¹⁹ manifests itself in many ways. The primary involvement consists of a transient herpetiform or ulcerative lesion on the genitalia which appears after an incubation period of only a few days. This usually escapes notice. Invasion of the inguinal lymph nodes draining the area of inocu-

lation usually occurs within 10 to 30 days after infection. The inguinal lymphadenitis is, therefore, commonly the first manifestation of the disease. Constitutional symptoms consisting of malaise, headache, fever and other grippe-like signs may be observed concurrently. The lymph nodes usually suppurate and form buboes. Involvement of other organs may occur at this time or only after a latent period of months to years. Many different lesions have been reported associated with lymphogranuloma venereum but evidence in support of such diagnoses has varied greatly. Koteen, therefore, classified the lesions said to be due to lymphogranuloma venereum into three groups: one, lesions from which the virus has been recovered; among other parts of the body are the conjunctiva and meninges. The second group, lesions from which the virus has not been recovered, but in which the supporting evidence is good; among other portions of the body are the cervical and axillary lymph nodes, tongue and lip. Third, those in which the supporting evidence is only circumstantial, as pharyngitis, tonsillitis and ocular lesions other than conjunctivitis. Clinical signs of lymphogranuloma venereum can be supported by various laboratory tests which offer the confirmatory or even the final proof of the disease.

A Frei test, in which a reaction is elicited by injecting lymphogranuloma venereum antigen intradermally, is the most commonly used. Biopsy of the lesion may reveal intracellular inclusion bodies which are suggestive of the diagnosis. Recovery of the specific virus—final proof of the diagnosis is afforded by isolation of the causative agent. Other laboratory reports may lend supportive evidence, as, for instance, the white blood count is usually elevated 10,000 to 20,000, the serum proteins may be elevated with increase in the globulin fraction and the level usually exceeds 8 gm. per 100 cc. The sedimentation rate is commonly elevated. The formaldehyde-gel test frequently elicits a positive reaction.

MALIGNANT LYMPOMA.

Hellwig²⁰ reports a clinical pathologic study of 130 cases of malignant lymphoma, of which nine involved the neck.

Cytologically, eight types of malignant lymphoma were distinguished corresponding to different degrees of differentiation of their component cells. There was a close correlation between the histology and life expectancy of the different subgroups. The average duration of disease was found to be 26.7 months for the entire series. It varied in the different histologic types between three months and four years. Due to its striking initial effect on lymphoma, irradiation therapy may occasionally save a life when the tumor is located in the vital part of the body inaccessible for surgery, but it will seldom prolong life expectancy inherent to the histologic type of lymphoma. Early surgical removal of a primary focus of disease offers the best chance of cure. In his series, 24.6 per cent of the patients survived five years or longer, regardless of postoperative radiation. In 21 patients with a single primary focus, radical surgery alone was used and 12 of the 21 patients survived from five to 20 years.

DIVERTICULA OF THE ESOPHAGUS.

New concepts of the etiology and treatment of diverticula of the esophagus brought out by King²¹ are a general agreement that esophageal diverticula are correctly divided into three groups: pulsion, traction and supradiaphragmatic; also, that a high percentage of all diverticula occur in the pharyngo-esophageal region and are of the pulsion type. He further states that after many dissections of the larynx and pharynx he came to the conclusion that the cricopharyngeus muscle is that portion of the inferior constrictor, the fibres of which pass transversely, and are attached to the cricoid cartilage, just below the inferior cornu of the thyroid cartilage. He describes his procedure, that when the neck of the sac has been entirely freed and traction has been made upon its fundus, the elliptical opening becomes rounded because of traction. The fundus is then grasped with an ordinary pair of triangular bladed forceps, the sac is freed and surrounding muscle fibres divided as previously described. A narrow bladed forcep is placed across the neck of the sac. A second forcep is placed parallel to the first and the neck of the sac is

amputated between the two. The cut edge of the sac is seared by electrocoagulation and a No. 00 chromic catgut suture on an atraumatic needle is passed through both walls of the remaining amputated stump, immediately behind, and next to the lock of the forcep. It is tied and continued for a couple of loose turns. This forcep is then removed. The suture is tightened and continued as a running suture, where it is again tied at the other end of the amputated neck of the sac.

If one is familiar with the anatomy of this region and understands the mechanics of the pharynx and esophagus and the development of an esophageal diverticulum, there should be no difficulty in effecting a cure by a one-stage operation.

TRACHEOTOMY.

Waldapfel,²² in his paper on Classic and Other Types of Tracheotomy, speaks of the emergency type of tracheotomy, which, as we all know, is a transverse incision through the cricothyroid membrane. It is without question a life-saving procedure. This opening is kept open until a regular tracheotomy can be performed. He then describes the regular tracheotomy procedure, using general anesthesia in children and local in adults. [Editor's Note: It would seem to me that in any case of a tracheotomy needed for dyspnea, no general anesthetic should be given.] The author states that a tracheotomy may be a simple operation or it may be a difficult one. The difference is the thyroid gland, and he explains the problem of how to handle it. The two most frequent complications of tracheotomy are hemorrhage and emphysema. This is a very good article for all to read.

Tracheotomy in the management of respiratory complications in poliomyelitis, Galloway²³ points out that anoxia, due to an accumulated secretion, is a most important factor in bulbar poliomyelitis. Early and adequate care, administration of oxygen, and proper postural drainage and aspiration will often suffice for recovery. With increasing signs of anoxia, further intervention must be weighed. It seems that indications for tracheotomy in poliomyelitis should be definitely set

up. The author states that the indications for tracheotomy in this particular disease are as follows:

First, fluid in the upper airway, with signs of anoxia increasing in spite of administration of oxygen, postural drainage and aspiration; restlessness, dyspnea, cyanosis, disorientation and mental depression are important determinants.

Second, unconsciousness or marked restlessness in a patient not previously treated and not responsive to any other treatment in a few moments.

Third, marked restlessness or stupor in a patient in a respirator even if he apparently has a spinal type of poliomyelitis.

Fourth, fluid accumulation, not otherwise easily and certainly taken care of, in a patient requiring a respirator.

Fifth, the rapidly, progressive bulbar symptoms as recommended by the Minneapolis group.

Sixth, bilateral paralysis or spasm of the vocal cords.

Seventh, markedly increasing signs of vasomotor failure not explained as due to a cause other than anoxia.

Eighth, untrained or inefficient attendants, inadequate equipment, or poor cooperation of the patient, with doubt that the airway will be kept constantly free of secretion.

Priest,²⁴ *et al.*, also state their experience with tracheotomy in patients with bulbar poliomyelitis treated at the University of Minnesota Hospitals and the Minneapolis General Hospital during the 1946 epidemic. During this epidemic 1,830 cases of poliomyelitis were treated. Approximately 400 were diagnosed as bulbar cases. Tracheotomies were performed in 75 of these. As the result of their experience they believe that tracheotomy has an important place in the treatment of bulbar poliomyelitis. In certain patients they thought it a life-saving procedure. There is reluctance on the part of some physicians to accept tracheotomy as a useful adjunct in the treatment of poliomyelitis. Their criteria for tracheotomy in bulbar polio-

myelitis was in two groups. The first group included patients over 14 years of age. The second group consisted of pediatric patients. In the adult group a tracheotomy was done on any patient whose bulbar symptoms were early and whose disease was progressing rapidly, or who had evidence of involvement of the circulatory or respiratory centers, or who had severe toxicity or mental changes. In the pediatric service the patient with bulbar poliomyelitis who had laryngeal paralysis severe enough to allow leakage of pharyngeal secretion into the larynx and trachea was subjected to tracheotomy only when he could not clear his own airway, or when his airway could not be cleared for him by pharyngeal aspiration and postural drainage. The inability of the patient to clear his own airway was indicated by recurrent cyanosis, bubbling rales in the chest, laryngeal stridor and the inability to cough efficiently. Aspiration bronchitis and pneumonitis, anoxia and fatigue are the conditions to be minimized by keeping the airway clear. The authors have had several experiences which have demonstrated to their satisfaction that gross amounts of pharyngeal secretion and food do enter the trachea and cannot be evacuated by the patient. In their summary of 75 tracheotomies done, 29 of these patients survived. They emphasize the detrimental effect of anoxia on the central nervous system. They believe that in their experience tracheotomy improves the chance for survival of properly selected poliomyelitis patients, if done before anoxia has produced sufficient central nervous system changes. That tracheotomy used in conjunction with various means producing artificial respiration will enable some critically ill poliomyelitis patients to survive until natural recovery of damaged neural tissue can occur.

Beck²⁵ reports a case of deep neck infection of the submaxillary type in a two and one-half months old infant, in which he emphasized the difficulty in making an exact diagnosis until after complete restoration of the airway by a tracheotomy. He also calls attention to the fact that in many of these deep infections of a Ludwig's type, the tracheotomy should be the first step.

Martin²⁶ has designed an introducer for tracheostomy tubes

to facilitate the introduction of the breathing tube at the time of the tracheotomy. It consists of a curved, bluntly pointed, hollow obturator whose tip has numerous perforations, so that when inserted through a slit in the trachea its presence within the trachea lumen can be detected by an exchange of air. The tracheostomy tube introducer resembles an emergency instrument, except that when inserted it carries with it the standard tracheostomy tube. He considers the device indispensable in those cases where the trachea has been displaced or overgrown by tumor tissue, or where actual exposure of tracheal cartilages is difficult or impossible, due to dense scarring of previous irradiation or surgery.

CANCER OF THE LARYNX.

Unusual laryngeal lesions in which Schall²⁷ reports two noteworthy cases of laryngeal carcinoma. In one, a situation of dual respiratory tract carcinoma, with a nine-and-one-half-year free interval was encountered, and in another, a recurrence in an identical lesion eight years following simple biopsy, is described. Also, a case of localized primary idiopathic amyloid disease confined to the larynx. The most common site of the localized type is in the upper respiratory tract, particularly the larynx, and the disease is infrequently met with. Since it is almost impossible to remove all the abnormal tissue, the "tumor" tends to recur and may require repeated removals. When the tumor is large and subglottic it is preferable to do a thyrotomy with removal and electrocoagulation to the base.

Rosedale²⁸ says that among the unusual tumors of the larynx, chondroma is not common. They are benign tumors of mesodermal origin with characteristics of hyaline cartilage. They are of fairly firm consistency and usually bluish-gray in color. The symptom complex depends upon the location or site of the chondroma. Symptoms, naturally, are those of impairment of voice, if within the lumen of the larynx, followed by obstructive dyspnea and with the increasing size of the tumor, later dysphagia.

The treatment comes under two headings: if it is a small tumor it may be removed by a thyrotomy, or if it is large, causing difficulty in swallowing, the entire tumor and possibly the larynx will have to be removed, although the author states that total laryngectomy seems unnecessary and too radical.

New²⁹ also states that neurogenic tumors occurring primarily in the throat are rare, and there are probably few other tumors about which there is so much confusion. He reports a case of neurofibroma of the larynx in which the only symptom was a persistent hoarseness slowly increasing over a period of 10 to 12 years. In another case the tumor was situated on the posterior surface of the arytenoid cartilage and caused noisy breathing for about a year; this patient was a child five years of age. The usual site is the ventricular band or the aryepiglottic fold. Tumors of this type are usually smooth and round, without mucosal ulceration, and it is difficult or impossible to obtain tissue for biopsy. The tumor was removed under suspension laryngoscopy and in the other it was necessary to do a thyrotomy to expose the tumor adequately for its removal.

Finally, Mills³⁰ reports a case of simultaneous cancer and malignant lymphoma of the larynx. The finding of an unsuspected lymphoma in a larynx removed for an obvious carcinoma emphasizes the value of a careful microscopic examination of the specimen, even when the diagnosis of carcinoma has been established previously by a biopsy.

With respect to the pathologic diagnosis, the coexistence of a squamous tumor and a lymphoid tumor in the same larynx raises the question of a lymphoepithelioma. Realizing that lymphoepithelioma of the larynx is very rare—only one case has come to their attention, the one reported independently by Marx and Vossenberg. Also, primary lymphomas of the larynx are rare.

CLASSIFICATION.

There seems to be much confusion as to the proper classification of cancer of the larynx. Walsh³¹ attempts to clarify

this by stating that, first, it is the site and extent of the lesion and, second, its histologic variety.

It is generally agreed that cancer in any part of the body is most successfully treated if it can be totally extirpated. Especially is this true of cancer of the larynx. With these considerations in mind, the following classification of cancer of the larynx is suggested by the author:

I. Intrinsic: Confined to the true vocal cord only.

II. Endolaryngeal: Involving structures within the laryngeal box, as the ventricles, ventricular bands, arytenoids and interarytenoid space; also those cancers of the vocal cord which have spread across the anterior commissure, with or without fixation of the vocal cord or arytenoid.

III. Subglottic Type.

IV. Extrinsic or Extralaryngeal Type.

Cancer of the larynx occurring in the second decade of life is very rare. Orton²² reports such a case in a child 13½ years of age. The laryngeal examination showed a granular growth, papillomatous in character, involving both arytenoids, with ulceration of the right arytenoid with cartilage exposed. This growth was so large that it almost completely closed the chink of the glottis. A very noticeable odor was present. There was a large fixed mass of glands on the right side of the neck just below the angle of the jaw, also some on the left side. The picture was that of malignancy and a biopsy was taken, which was diagnosed "carcinoma, actively malignant."

After deep X-ray therapy the larynx showed considerable regression of the growth. The left side of the larynx was markedly improved, and the swelling on the right side smaller; however, this regression was not of long duration. Later the patient complained of some pain in his right knee. X-rays were taken of the knee and the chest and showed the chest to be negative. The right knee revealed a gouged-out appearing area of bone destruction involving the outer portion of the proximal end of the tibia extending into the shaft through the

midline — diagnosis: metastasis of carcinoma. The patient's condition became progressively worse, succumbing to metastasis both in the glands of the neck, bones and the brain. This is the youngest patient I have seen with carcinoma of the larynx.

The methods and treatment of carcinoma of the larynx with their results are brought out by New,²³ who states that in recent years the frequency and seriousness of carcinoma of the larynx have become generally recognized and physicians have developed an increasing interest in the treatment of this disease. The paper covers 568 patients treated, 446 of whom were operated upon, and 122 were treated by irradiation. Under the various types of operation, total laryngectomy was done in 213, thyrotomy was done in 184 and laryngeal suspension in 49, with eight hospital deaths, or 1.8 per cent operative mortality.

As to irradiation, they state at their clinic that the irradiation of laryngeal carcinoma is a form of therapy reserved for high grade, radiosensitive lesions which are too extensive to warrant treatment by surgical measures. Of the total number of patients traced after operation, there were 185; living five or more years following operation, 136, or 73.5 per cent. The five-year survival rate of patients treated by irradiation, total number treated was 76. Total number traced, 72. Total number of patients that lived five years or longer, five, or 6.9 per cent. In their comment they express their conviction that carcinoma of the larynx is a curable disease, particularly when diagnosed accurately and early; however, they believe that no one form of therapy is superior to all others in the treatment of this disease. On the contrary, the type of growth in question, its activity, extent and location and the age and general physical condition of the patient should be factors which determine what type of treatment should be instituted in each individual case. In general, low grade laryngeal carcinomas should be treated by surgical measures, while extensive high grade, radiosensitive tumors require irradiation. Successful surgical therapy for carcinoma of the larynx is not a question of operative technique alone but of the coordi-

nation and the collective efforts of the surgeon, pathologist, anesthetist, assistants and nurses.

Kemler³⁴ describes a bilateral thyrotomy for carcinoma of the larynx. Laryngofissure is indicated only when the growth is situated in the anterior two-thirds of the cord without fixation. In his conclusions he states that his operation is a simple one, easy and a thorough method of extirpation of laryngeal carcinoma.

McCart,³⁵ in a series of 23 laryngectomies for carcinoma of the larynx, states that all cases showed squamous cell on pathological section. He had no immediate deaths, and all but two of this group are alive and well. One patient died from an extensive internal hemorrhage three weeks following operation. The second patient died six months following operation. All other patients have resumed normal occupations. All his patients were greatly assisted in rehabilitation by means of pharyngeal speech. The author emphasizes this very important part of the after-care. It takes a little time, but the results are well worthwhile.

Orton,³⁶ in speaking of the pathology and surgery of extrinsic cancer of the larynx, reported 51 cases of extrinsic carcinoma of the larynx, in which surgery was resorted to, resulted in 27 per cent five-year cures. These growths involved the epiglottis, aryepiglottic fold, pre-epiglottic space, pyriform sinus and postericoid area, and required extensive resection of the pharyngeal tissues, as well as in some cases bilateral removal of the regional lymph nodes. Compared to irradiation in this type of growth, the surgical were more favorable. Reports of success from irradiation therapy, so frequently labeled as "regression," cannot be considered as cures when the five-year limit is applied. He states that radium and X-ray therapy should be used only when the patient refuses surgery or when the case is clearly inoperable. In many the pharyngostoma resulting from some of these operations can be closed by a plastic procedure at a later time.

Woodward³⁷ also advocates wide surgical removal in the extrinsic type of growth by doing a complete laryngocervical-

esophagectomy, in which he uses wide surgical excision of the tumors and adjacent structures, as well as movable cervical lymph nodes. He further states that these patients do not find life unhappy or burdensome with their handicaps. Until a more specific method of treatment of carcinoma presents itself, the author will continue to advocate wide surgical removal, followed by irradiation therapy in selected patients, in an effort to effect a cure.

The above articles are further supported by Brunschwig,³⁸ wherein he reports a one-stage resection of the entire cervical esophagus, hypopharynx, larynx, cervical trachea, and cervical lymph nodes bilaterally for carcinoma arising in the upper portion of the cervical esophagus just behind the larynx. This indicates the extent to which surgical attack upon esophageal cancer in the neck is possible.

We become a little more conservative in the surgical treatment of cancer of the larynx when Jesberg,³⁹ in his conclusions on the subject, states that, first, laryngofissure with cordectomy if the cord is motile, and laryngofissure with removal of underlying laryngeal cartilage if the cord is fixed. Second, that cordal cancer approaching the anterior commissure should be treated by removal of the anterior part of the opposite cord with laryngofissure. Third, cordal cancer that has involved the larynx beyond the extent of the true cord calls for a laryngectomy. Fourth, if the cancer is extensive or high grade malignancy, a preliminary course of irradiation should be done before surgery is attempted.

ROENTGEN THERAPY.

Lenz⁴⁰ states that Roentgen therapy for cancer of the larynx depends on the administration of sufficient X-rays to destroy the cancer while preserving the recovery power of the simultaneously irradiated uninvolved larynx and laryngopharynx. The gravity of chondronecrosis differs as to whether it occurs in the arytenoids, the epiglottis or the more rarely invaded thyroid cartilage. Involvement of the latter is usually limited to far advanced cases which are incurable by Roentgen therapy.

The author in his conclusions states that Roentgen therapy in early cancer of the cords gives as high rate of cure and a better voice than laryngofissure. They recommend Roentgen therapy in all cancers of the vocal cord except when the cancer has extended subglottically or into the arytenoid cartilage. In these cases they prefer laryngectomy followed by Roentgen therapy if clinically there is persisting cancer or if microscopic examination of the laryngectomy specimen shows that the removal was incomplete.

He states that cancer of the pyriform sinus usually invades the arytenoid cartilage and early metastasizes to the cervical lymph nodes. Roentgen therapy has failed to cure most of these cancers. Laryngectomy and postoperative Roentgen therapy might yield better results. Prognosis is grave when cancer of the cord or pyriform sinus has metastasized to lymph nodes. If movable, they should be removed radically, and, if fixed, treated by radium or Roentgen therapy.

The danger of necrosis of the laryngeal cartilages following Roentgen ray or radium therapy to the thyroid gland has been pointed out many times in the past. McGovern⁴¹ reports a fatal case of perichondritis of the larynx following the interstitial application of radium to the thyroid gland and he cites it to emphasize the hazard of this form of treatment.

Some authorities state that to avoid the disastrous effect of radiation injury to the laryngeal cartilages in inoperable cases of cancer of the throat, they advise preliminary removal of the entire thyroid cartilage. Modern methods of irradiation to the neck have reduced this complication to a minimum. Radionecrosis of the laryngeal cartilages, however, will be an occasional complication and, because of its seriousness, deserves close observation and prompt treatment.

BIBLIOGRAPHY.

1. BROWN, J. MACKENZIE: Chairman's Address, American Medical Association, Atlantic City, June, 1947.
2. FENTON, RALPH A.: A Brief History of Otolaryngology in the United States from 1847 to 1947. *Arch. Otolaryngol.*, 46:2:153, Aug., 1947.

3. FURSTENBERG, A. C.: A Chronicle of 100 Years of Otolaryngology. *THE LARYNGOSCOPE*, LVII:9:596, Sept., 1947.
4. HOLINGER, PAUL H.; ANDREWS, ALBERT H.; ANISON, GEORGE C., and JOHNSTON, KENNETH C.: Pathology of the Larynx—A Photographic Analysis. *Ann. Otol., Rhinol. and Laryngol.*, LVI:3:583, Sept., 1947.
5. NEW, GORDON B.: Congenital Cysts of the Tongue, the Floor of the Mouth, the Pharynx and the Larynx. *Arch. Otolaryngol.*, 45:2:145, Feb., 1947.
6. ADAMS, W. STIRK: A Branchial Cleft Appearing as a Post-Tonsillar Abscess. *Jour. Laryngol. and Otol.*, LXI:10:552, Oct., 1946.
7. ROSENBERGER, HARRY C.: Contact Ulcer of the Larynx. A Case Report. *THE LARYNGOSCOPE*, LVII:4:272, Apr., 1947.
8. PEACHER, GEORGIANA, and HOLINGER, PAUL: Contact Ulcer of the Larynx. *Arch. Otolaryngol.*, 46:5:617, Nov., 1947.
9. WALKER, JAMES S.: Neurinoma of the Larynx. *Ann. Otol., Rhinol. and Laryngol.*, LVI:4:898, Dec., 1947.
10. SMITH, MORLEY T.: Adenoma of the Trachea. *Arch. Otolaryngol.*, 46:3:405, Sept., 1947.
11. MARTIN, LT. COL. BRUCE C., and ALBRIGHT, COL. ARNOLD A.: Report of Two Cases of Stenosis of the Larynx and Trachea. *Ann. Otol., Rhinol. and Laryngol.*, LVI:4:1007, Dec., 1947.
12. LASZLO, ALEXANDER F.: Temporary Complete Paralysis of Both Recurrent Laryngeal Nerves Due to an Extension Cast Applied for Scoliosis. *Ann. Otol., Rhinol. and Laryngol.*, LVI:1:216, Mar., 1947.
13. KELLY, JOSEPH D.: Surgery of the Larynx in Bilateral Abductor Paralysis. *Jour. A. M. A.*, 134:11:944, July, 1947.
14. LICHTENSTEIN, MANUEL E.: Acute Injuries Involving the Large Blood Vessels in the Neck. *Surg., Gynec. and Obst.*, 85:2:165, Aug., 1947.
15. LICHTENSTEIN, MANUEL E.: Acute Injuries to the Neck Involving the Food and Air Passages. *Surg., Gynec. and Obst.*, 85:6:734, Dec., 1947.
16. PEACHER, WILLIAM G.: Speech Disorders in World War II. *Arch. Otolaryngol.*, 46:3:282, Sept., 1947.
17. TUFT, HAROLD S., and RATNER, SIMON H.: Laryngeal Polypoid Granuloma Following Intratracheal Anesthesia. *Ann. Otol., Rhinol. and Laryngol.*, LVI:1:187, Mar., 1947.
18. BARTON, LEWIS W.: Granuloma of the Larynx. *Ann. Otol., Rhinol. and Laryngol.*, LVI:1:191, Mar., 1947.
19. SCHEIE, HAROLD G.; CRANDALL, ALAN S., and HENLE, WERNER: Keratitis Associated with Lympho-Granuloma Venereum. *Jour. A. M. A.*, 135: 6:333, Oct., 1947.
20. HELLWIG, C. ALEXANDER: Malignant Lymphoma. The Value of Radical Surgery in Selected Cases. *Surg., Gynec. and Obst.*, 84:5:950, May, 1947.
21. KING, BRIEN T.: New Concepts of the Etiology and Treatment of Diverticula of the Esophagus. *Surg., Gynec. and Obst.*, 85:1:93, July, 1947.
22. WALDAFFEL, RICHARD: Classic and Other Types of Tracheotomy. *Arch. Otolaryngol.*, 45:4:446, Apr., 1947.
23. GALLOWAY, THOMAS C.: Management of Respiratory Complications of Poliomyelitis. *Arch. Otolaryngol.*, 46:2:125, Aug., 1947.
24. PRIEST, ROBERT E.; BOIES, LAWRENCE R., and GOLTZ, NEILL F.: Tra-

cheotomy in Bulbar Poliomyelitis. *Ann. Otol., Rhinol. and Laryngol.*, LVI:2:250, June, 1947.

25. BECK, AUGUST L.: Deep Neck Infection, Submaxillary Type, in a Two and One-half Months Old Infant. *THE LARYNGOSCOPE*, LVII:11:722, Nov., 1947.

26. MARTIN, HAYES: An Introducer for Tracheotomy Tubes. *THE LARYNGOSCOPE*, LVII:3:240, Mar., 1947.

27. SCHALL, LeROY A., and JESBERG, NORMAN: Unusual Laryngeal Lesions. *Ann. Otol., Rhinol. and Laryngol.*, LVI:4:904, Dec., 1947.

28. ROSEDALE, RAYMOND S.: Laryngeal Chondroma. *Arch. Otolaryngol.*, 45:5:543, May, 1947.

29. NEW, GORDON B., and DEVINE, KENNETH D.: Neurogenic Tumors of Nose and Throat. *Arch. Otolaryngol.*, 46:2:163, Aug., 1947.

30. MILLS, WARDELL, H.; DOMINGUEZ, RAFAEL, and McCALL, JULIUS W.: Simultaneous Carcinoma and Malignant Lymphoma of the Larynx. Case Report and Review of Literature. *THE LARYNGOSCOPE*, LVII:7:491, July, 1947.

31. WALSH, THEODORE E.: The Classification of Carcinoma of the Larynx. *THE LARYNGOSCOPE*, LVII:6:414, June, 1947.

32. ORTON, HENRY B.: Carcinoma of the Larynx. Clinical Report of Case—Age 13½ Years. *THE LARYNGOSCOPE*, LVII:4:299, Apr., 1947.

33. NEW, GORDON B.; FIGI, A.; HAVENS, FRED Z., and ERICH, JOHN B.: Carcinoma of the Larynx; Methods and Results of Treatment. *Surg., Gynec. and Obst.*, 85:5:623, Nov., 1947.

34. KEMLER, JOSEPH I.: Bilateral Thyrotomy for Carcinoma of the Larynx. *THE LARYNGOSCOPE*, LVII:11:704, Nov., 1947.

35. MCCART, HOWARD: Surgical Treatment of Cancer of the Larynx. *Canad. M. A. Jour.*, 55:365-368, June, 1946.

36. ORTON, HENRY B.: The Pathology and Surgery of Extrinsic Cancer of the Larynx. *Ann. Otol., Rhinol. and Laryngol.*, LVI:4:1081, Dec., 1947.

37. WOODWARD, FLETCHER D.: The Surgical Treatment of Postcricoid and Cervical Esophageal Carcinoma. *Ann. Otol., Rhinol. and Laryngol.*, LVI:4:1035, Dec., 1947.

38. BRUNSCHWIG, ALEXANDER, and CAMP, EDWARD: One-Stage Resection of Total Cervical Esophagus, Larynx, Base of Tongue, Hypopharynx, Cervical Trachea and Bilateral Cervical Lymph Node Chains for Carcinoma Primary in the Cervical Esophagus; Reconstruction of Cervical Esophagus. *THE LARYNGOSCOPE*, LVII:5:305, May, 1947.

39. JESBERG, SIMON: Surgical Treatment for Carcinoma of the Larynx. *Jour. A. M. A.*, 134:2:121, May, 1947.

40. LENZ, MAURICE: Roentgen Therapy in Cancer of the Larynx. *Jour. A. M. A.*, 134:2:117, May, 1947.

41. MCGOVERN, FRANCIS H.: Perichondritis of the Larynx Secondary to Interstitial Application of Radium to the Thyroid Gland. Report of a Fatal Case. *Ann. Otol., Rhinol. and Laryngol.*, LVI:1:206, Mar., 1947.

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CLINICAL OBSERVATIONS ON THE MOVEMENT OF NASAL CILIA. AN EXPERIMENTAL STUDY.*

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During recent years our knowledge of nasal physiology has been considerably increased. This is due in great measure to refinements in microscopic and histologic studies of the cilia making it possible to observe and measure their size. When Leeuwenhoek made the first microscope, about 1650, he opened up an entirely new field and described his findings of ciliary movement in certain minute animals.

In the lower forms of aquatic animal life cilia play a most important part, both as a means of locomotion and in the ingestion of food. These microscopic organisms are dependent on the cilia over their body surface to move them about in the water. This movement is necessarily slow, as it is not influenced by muscular action. In the higher vertebrates, including man, with greater body metabolism, active motion and the swallowing of food is carried out by powerful muscular action, and from that point of view cilia play a secondary rôle. This is well shown in studying the growth and transition of the tadpole to the frog. Before the embryo is hatched from the egg, cilia appear and by the time it reaches 3 mm. in length the whole surface is covered with cilia. Definite currents are produced, which were described and carefully mapped out by Assheton¹ 51 years ago. These are constant and extend from the head over the back, lateral and ventral surfaces toward the tail. "By the time the tadpole is 6 to 7 mm. long, its cilia are capable of moving the organism over the surface of a flat glass vessel at the rate of 1 mm. in four to seven seconds. As the embryo increases in size and approaches the frog stage, the ciliary currents become less powerful" and finally disappear

*Presented as Candidate's Thesis to the American Laryngological, Rhinological and Otological Society, Inc., 1948.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, Feb. 20, 1948.

from the body surface altogether. In the full grown frog, as in all vertebrates, including man, ciliated epithelium is limited to lining surfaces such as the respiratory tract, the esophagus and urogenital tract.

Of particular interest to the rhinologist is the distribution of ciliated mucous membrane in the upper respiratory tract. This begins just above the vestibule in the nose and extends upwards into the nasolacrimal duct and sac. The whole lining membrane, including the sinuses, is covered with cilia and this spreads over the upper surfaces of the soft palate, the nasopharynx and along the Eustachian tube to the tympanum. The only portion of nasal mucous membrane which is not ciliated is the olfactory area on the septum and on the corresponding part of the lateral wall. In a healthy nose, mucus is carried by the cilia downward into the pharynx where it is either swallowed or coughed up. Conditions in the lungs are somewhat reversed. Although the larynx, bronchi and terminal bronchioles are lined with ciliated epithelium, the movement of the cilia is toward the glottis. By this means alone mucus is carried upward from the smallest bronchioles to the hypopharynx where it is again cleared from the throat or swallowed.

Cilia are primitive but hardy structures. In animal life, cells containing cilia are found originating from ectoderm, mesoderm and endoderm, while muscles are normally derived from mesodermal cells alone.

Each complete movement or cycle of a cilium consists of an effective stroke when work is being done and a slower recovery stroke. Although we are not absolutely certain that their action is identical, our knowledge of human cilia is greatly enhanced by a study of ciliated surfaces in lower forms of animal life.

According to Gray,² the simplest form of ciliary activity is pendular movement (see Fig. 1A). This is found in heterotrichous ciliates and is a simple to and fro motion, as in the pendulum of a clock. The cilia, being more or less rigid, move forward and backward through the same arc, bending only at

the base. The only difference in the movement is that the forward effective stroke is more rapid than the recovery stroke. It is obvious from this arrangement that movement is necessarily very slow as so much energy is lost on the recovery stroke.

Another and more common elementary type of motion is called flexural movement (see Fig. 1B). It is found in certain mollusks and when the cilium is at rest it is perfectly straight. Movement begins at the tip instead of the base of the cilium



Fig. 1. (A) The arrows indicate the same path traced by the effective and recovery strokes, as the cilium bends only at the base. (B) The arrow on the left, pointing downward, shows the effective stroke and the arrow on the right, turned upward, the recovery stroke. The straight cilium at the extreme right and left of the diagram shows the end of the recovery stroke and the period of rest.

and extends down to the base. At the end of the effective stroke, the cilium resembles an inverted fish hook, but as the slower recovery stroke takes place it straightens out, beginning at the base and extending to the tip.

A combination of these two simple forms of ciliary movement is found in some of the mollusks, particularly the *Mytilus edulis*. By means of tiny particles of carmine, Gray³ found the frontal cilia on the gills of *Mytilus* a more suitable medium than the convenient and classical method of observing ciliary motion on the mucous membrane on the roof of a frog's mouth. He carefully studied the cilia and their movement, which closely resembles those found in the human nose, estimated the rate of speed and direction of the ciliary currents and described the effective and recovery stroke. Two years later, in 1924, Carter⁴ corroborated these findings.

In the effective stroke (A), the cilium attached to a cell appears to move as a rigid steel spring through 180 degrees, while on the recovery stroke (B) it curls back on itself as a flaccid thread from the base to the tip. The complete movement forward and backward takes place in the same plane.

There are certain differences, however, between the cilia of many lower forms of animal life and those in the human nose.

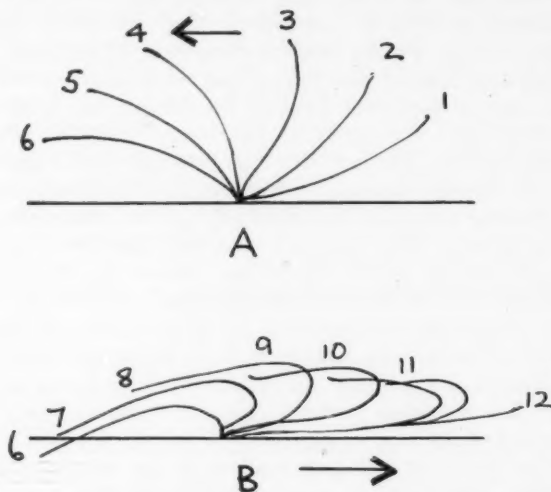


Fig. 2. The above diagram (A) shows the forward effective stroke of a frontal cilium of *Mytilus*, and (B) the slower flexible, backward stroke. The movement begins at the base and spreads to the tip. (After Gray.)

In the *Mytilus*, for instance, the cilia are about 10 u. in length and they oscillate at the rate of 12 times every second (720 times a minute). Human nasal cilia are approximately 7 u. long, that is, slightly larger than a red blood corpuscle, and the space between each cilium is about equal to its own diameter.⁵

The beat is also slower in man, the rate being four to six cycles per second (250 times a minute) and the amplitude of each cycle is not so great. On the other hand, a great amount

of information which is applicable to the human nose has been obtained by the study of ciliary action in these lower animals. Although we have learned a great deal about cilia in the past two decades, we are apt to forget that their presence and motion were observed over a century ago.

In 1830, Sharpey⁶ described some careful experiments he had carried out on ciliary movement. He stated that Purkinge and Valentin⁷ were the first to recognize and mention the movement of cilia in mammals. They carefully noted the motion of cilia "on the mucous membrane of the nose and its sinuses and that of the Eustachian tube, also on the lining membrane of the lower part of the larynx, the trachea and bronchial tubes, extending to their smallest divisions capable of examination. No trace of it can be found in the glottis, nor in the mouth and pharynx." Sharpey injected powdered charcoal into the nose and sinuses of rabbits and observed the ciliary pathways. "On breaking open the maxillary sinus and trying its lining membrane in the same way, the impulsion seemed to be directed towards the back part of the cavity, where its opening is situated." (This has more recently been noted by Hilding,⁸ who injected India ink into human antra and described the spiral streaming which converges at the ostium due to ciliary action.) "By the same means I traced the direction in the windpipe of a young dog a few days old; the impulsion was best marked on the posterior part of the tube, and there it was obviously directed toward the larynx..."

Many of Sharpey's observations have only recently been corroborated; for instance, he carefully noted that cilia were tough, hardy structures that kept on beating long after death of the animal. He observed the quick effective and the slower recovery stroke of cilia and also measured their length.

During the last few years many of the drugs commonly used in nasal medication have been found to interfere with the overlying mucus blanket and injure the cilia. It is interesting to note that Sharpey described the effect of drugs on ciliated membrane nearly 120 years ago. In part he said, "Acid, alka-

line and saline solutions when concentrated arrest the motion instantaneously; dilution to a degree varying in differing substances prevents this effect altogether, and a lesser degree of dilution delays it." Among the solutions he used were alcohol, quinine, ether, atropine and morphia.

Chemical agents affect ciliary activity on the esophageal cilia of the frog in much the same way as they do on nasal mucosa. This also applies to heat and cold. In general, normal saline does not injure or interfere with their movement, but as the concentration of salt is increased, the beat is slowed down and, if continued, finally stops. Tap water and distilled water on human nasal mucous membrane causes a definite slowing of the ciliary beat.⁹ Increasing the hydrogen ion (pH) concentration within the cells of sea urchins by submerging them in an acid medium reduces ciliary activity.¹⁰ Conversely, a decreased pH above seven on the alkaline side increases the rate of ciliary movement. In the same manner, any rise in temperature up to 32.5° C. increases the beat of the cilia, while a lowering of the temperature slows up the ciliary beat.

Clinically, according to Negus¹¹ (1934), nasal cilia beat vigorously in an alkaline solution and slow down in an acid medium of pH 6.4 or less. In the same year, Tweedie¹² attempted to correlate the number of bacteria in the nose and sinuses with the pH values. He found that in patients showing an alkaline reaction, pH above seven, organisms were usually found, but when the pH was 6.5 or lower (acid) cultures were negative, although smears from the antrum showed many bacteria.

It was thought that pathogenic organisms would tend to diminish in an acid medium.

Most of the above observations followed the work of Yates,¹³ who, in 1924, injected a solution of dye into the various sinuses and described definite ciliary pathways into the pharynx. From the anterior group of sinuses the dye emerged under the posterior tip of the middle turbinate and streamed down in front of the Estachian tube. The posterior ethmoid cells drained down from the superior meatus and joined the

former track from the anterior group of cells in front of the Eustachian tube. A small stream went behind the opening of the tube and joined the previous tracks at the level of the soft palate. The stream from the sphenoid followed down the posterior pharyngeal wall behind the Eustachian cushion and joined the combined streams about half an inch below the soft palate and just medial to the posterior pillar of the tonsil.

These findings stimulated greater interest in ciliary activity and a number of articles appeared in the literature.

The movement of cilia can be easily studied by simply folding a piece of nasal mucosa on itself so that they are seen in profile. Although various groups of cilia beat at the same rate, they do not beat in unison in the same phase. Each particular cilium is slightly in advance of the one behind it in the group and slightly behind the one just in front of it. This movement, called metachronal rhythm, is found in nearly all ciliated epithelium. Since all the cilia seen in the same plane across the epithelium do not beat in the same phase, regular waves are formed which pass over the surface. This action has frequently been compared to a field of waving grain when the wind passes over it. The crests of the waves show the cilia at the height of their effective stroke and the troughs or low points, cilia at or near the beginning of the recovery stroke.

A layer of mucus covers the mucous membrane of the whole respiratory tract, including the nose, sinuses, nasopharynx, trachea, esophagus and down into the stomach. It is one continuous mucinous layer which moves downward and backward toward the nasopharynx, where it is either coughed up or swallowed. As the secretion is moved along by ciliary action, aided by traction, by gravity and by the act of swallowing, it is constantly being replaced by more from the goblet and serous glands of the nasal mucosa. The rate of movement of this film of mucus due to ciliary action varies in different areas. In the vestibule lined by squamous epithelium and no cilia, there is no movement. According to Hilding,¹⁴ the mucous membrane of the anterior third of the nose, including

the anterior ends of the middle and inferior turbinates, shows very little ciliary activity.

The ciliated columnar type of epithelium which is present at birth is soon changed in character to a more stratified



Fig. 3. Over the anterior one-third of the lateral wall (dotted) there is a new layer of mucus every hour or two, and over the posterior two-thirds a new film of mucus about once every 10 minutes. (The solid white lines from the anterior third show the direction of drainage, and the broken lines from the posterior two-thirds of the nose the more rapid flow of mucus downward and backward.

squamous variety due to inspired air which carries dust, smoke, foreign particles, etc.

Similarly, in the same way the anterior part of the septum shows a metaplasia to a lower form of squamous epithelium without cilia.

The same applies to deflections, ridges and spurs on the

septum—in short, wherever the impact of inspired air is greatest in the anterior part of the nose. In this inactive area of the lateral wall, the film of mucus moves downward and backward into the meatuses very slowly and is renewed every hour or two. On the corresponding area of the septum, the movement is also slow—foreign particles moving at the rate of a few millimeters per hour. The posterior two-thirds of the nose is covered with ciliated columnar epithelium, and movement in this active area is much more rapid.

The secretion of mucus here is more abundant and it moves at the rate of 4 to 6 mm. per minute. Particles of lamp black move from the anterior attachment of the middle turbinate to the opening of the Eustachian tube in from four to 10 minutes. In other words, there is a new layer of mucus about once every 10 minutes in the posterior two-thirds of the nose, with a strong tendency to drain into the meatuses. Again, on the posterior two-thirds of the septum, the rate of flow is the same—4 to 6 mm. per minute. This protective coating with the cilia constitutes the first line of defense and acts as a conveyor belt which carries away dust and harmful bacteria within a few minutes. For this reason, cultures from the deeper recesses of the nose are so often found to be sterile.

During the past two years a clinical study has been carried out and ciliary activity noted under varying conditions. By means of a malleable cannula, there is no difficulty in blowing a little innocuous powder* into any desired area and timing its progress to the nasopharynx. A small funnel on the upper surface of the cannula for the powder is a convenience, as the head can then be held in the upright position. In the anterior part of the nose an anesthetic is rarely needed, but in the posterior half it is often necessary to anesthetize the anterior or posterior ethmoidal nerves as they emerge from the cribriform plate, and sometimes the sphenopalatine ganglion. A shrinking agent in the anesthetic is also beneficial.

*The powder used in this study was calcium phosphate (dibasic) 97 per cent, colored with a harmless orange dye of 3 per cent. (The dye called Edicol Orange is made by C.I.L.) This mixture is neutral, nonabsorbable and does not clump. In powder form it has a neutral or dusty pink color, but on a moist surface, such as the nasal mucous membrane, it turns a brilliant orange which is easily recognized. Various colors were used, but this was found most satisfactory.

Hundreds of cases have been studied in this way in office and hospital practice and the results tabulated. All the sinuses were injected under normal conditions and a great many when acute and chronic infections were present. Cases of atrophic rhinitis, vasomotor rhinitis and seasonal hay fever, with and without polypi, were also examined. Ciliary movement was noted on the septum when deflections, ridges and spurs were observed, and postoperatively after the obstructions had been removed.



Fig. 4. The type of cannula used.

The action of cilia and pathways were also mapped out where perforations were present due to tuberculosis, syphilis and occasionally from submucous resection.

In general, it might be stated that an adequate supply of healthy mucus aids and promotes normal ciliary drainage. Normal mucus varies in consistency but is made up of about three parts mucin, two parts salt and 95 parts water. If the proportion of mucin is increased so that the blanket of mucus is thick and sticky, ciliary activity is slowed down. On the other hand, where there is an excess of watery mucus present containing very little mucin, ciliary action is impeded. It was found during the hay fever season that an allergic mucous membrane by itself, without an excess of aqueous mucus, does not interfere with ciliary movement. The pale, boggy, water-

logged tissue carries the powder away from the inactive and active areas in a similar way to that mentioned for normal mucous membrane. Many cases were observed where powder sprayed over the posterior half of the turbinates and septum appeared at the level of the Eustachian tube within 10 minutes; however, when a profuse watery discharge is also present, powder placed in the posterior half of the nose, either on the septum or lateral wall, tends to remain for half an hour or more. Even in this active area, the secretion remains relatively stagnant. When polypi are present, either due to allergy or infection, there is an interference with normal ciliary movement. On the anterior surface of small, immature polypi, where ciliated epithelium still remains, there is definite movement; but as the polypi enlarge and are subjected to blasts of inspired air, the exposed surfaces become changed to a squamous type of epithelium without cilia, and powder remains sometimes for an hour or longer. On the posterior protected ciliated surfaces, powder drains away more freely.

In cases of atrophic rhinitis where the character of the mucous membrane has reverted to the squamous type of cell without cilia, the normal ciliary pathways are disturbed. Powder blown into the nose in the inactive area, anteriorly or further behind in the active area, tends to remain for a long time. Due to excessive dryness and crusting, as one would expect, normal drainage is disorganized. Isolated islands of normal appearing tissue show some activity, but ciliary movement often seems limited to the under surface of the turbinates and the protected meatuses. When the powder finally reaches the nasopharynx, it does not follow the normal path just medial to the posterior pillar but appears to be spattered over the posterior pharyngeal wall.

In children with adenoid tissue before operation, powder sprayed on the posterior part of the septum and lateral wall is often carried down in parallel streaks aided by traction, gravity and the action of swallowing. The ciliated surface of the adenoid is protected at the back of the nose and moves the powder along without difficulty. Following adenoidectomy, powder remains in the nasopharynx in isolated areas for a

longer period, depending upon the amount of scar tissue present, which, of course, does not contain cilia. In appearance the pattern is very similar to that seen in atrophic rhinitis.

Frequently in the early stages of a low grade fever with increased reddening of the nasal mucosa, ciliary motion is accelerated, but in chronic debilitated cases the action of the cilia is lessened. Also, in acute infections with high fever, ciliary activity is quickened, but if the fever is prolonged, the drying effect on the membrane tends to slow the beat of the cilia. According to Yates,¹⁵ nasal cilia cease beating when 10 per cent cocaine is applied to the mucous membrane. In uninfected cases the paralysis passes off in about two hours and then the normal beat is resumed. This impression is also shared by Lierle.¹⁶ In the presence of infection, as demonstrated by culture, recovery of the ciliary beat varies. For instance, nasal mucosa infected with streptococci shows a return to normal ciliary activity in about two hours after cocainization with 10 per cent cocaine—the same as uninfected tissue. When infected with staphylococci, there is a tendency for the ciliary beat to be slowed down and the recovery time after the use of 10 per cent cocaine more prolonged than normal. The thicker, tenacious pus in these cases may account for the delay. At times recovery is so slow after a severe infection "that one is uncertain whether the cilia previously damaged by toxins were killed by the cocaine and had regenerated, *i.e.*, 15 days. Recovery is patchy and not universal, being far more rapid in the areas other than the ciliary tracks."¹⁵

A number of patients were studied within a few days after submucous resection had been done and before the reaction had subsided. Powder was sprayed on the middle third of the septal mucous membrane 48 hours after operation, when the packs had been removed. In the vast majority of cases it appeared at the level of the Eustachian tube in about 10 or 15 minutes. The postoperative reactive swelling without infection or thick mucous did not seem to interfere to any extent with normal ciliary streaming. When profuse, heavy mucus without pathogenic organisms was present, it sometimes re-

quired 35 to 45 minutes. Septal resections tested in the same way months or years after operation showed normal movement downward and backward, the powder appearing at the edge of the soft palate within 10 minutes.

Ciliary streaming around septal perforations showed wide variations due to their position, size and the amount of scar tissue present. Powder blown on the posterior edge of a perforation on the anterior part of the septum often remained for an hour or two before being finally drawn backward by traction. Cross currents of inspired air through the perforation appeared to increase the dryness around the edges. Just behind the scar tissue, normal functioning, ciliated epithelium moved the powder away much more quickly.

Many rhinologists recommend electrocoagulation to shrink hypertrophied inferior turbinates in order to improve nasal breathing. Although this method is not universally accepted, owing to its destructive action on the mucous membrane, normal functioning mucous membrane with cilia has been noted six months to a year later in the few cases observed. The same injurious effect on the nasal mucous membrane applies to a lesser degree when sodium sulfathiazole is used repeatedly even after a few weeks.¹⁷ This caustic action is due to the increased alkalinity and the high pH of 10 or 11. When sodium salt is substituted for sulfonamides in propylene glycol and a 2 or 3 per cent solution buffered so that the pH is lowered to about six, these harmful effects are not as apparent; however, in view of recent findings it is doubtful whether sulfa compounds are absorbed to any degree from an intact mucous membrane and it is now thought that any beneficial result is obtained from the ephedrine or other shrinking agent in the solution which improves ventilation and drainage.

Three years ago it was noted that sodium and calcium penicillin in saline up to 5,000 units per cc. with a pH of six did not interfere with ciliary movement.¹⁸ This has been corroborated recently by Fabricant, *et al.*¹⁹ Unfortunately, when instilled into the nose it is carried away very quickly and the real problem in acute and subacute sinusitis is to retain the



Fig. 5. Section of head showing the direction of ciliary motion around an anterior septal perforation.

penicillin solution in the nose and sinuses long enough to act on penicillin-sensitive organisms. The same applies to streptomycin on Gram negative bacteria; however, once the infection penetrates to the submucosa and glands, it is doubtful

whether antibiotics or other bacterial agents applied locally or by displacement are of any avail.

The rate of ciliary movement varies in the presence of sinusitis. In general, it should be mentioned that a moderate amount of thin, watery secretion is carried away by the nasal cilia very rapidly. Fluid, creamy pus moves along at a slightly slower rate, while thick, curdy mucus, due to its consistency, as a rule, is moved with difficulty. Whether ciliary action is hindered by the physical properties of thick pus or the cilia are affected by toxins is still undetermined.

Many cases of acute and chronic sinusitis with a free discharge of pus in the middle meatus were examined. Powder blown into the middle meatus of the affected side in the neighborhood of the maxillary ostium reached the Eustachian tube in practically every case within 10 to 12 minutes. Pus from the right antrum which showed a pure culture of *staphylococcus aureus* appeared in the nasopharynx in 12 to 15 minutes. Creamy, yellow pus, pneumococcal in origin, from an acute frontal sinusitis, showed just behind the soft palate within 10 minutes.

Numerous cases of subacute infection of the antrum were sprayed with powder or a solution of the powder after puncture in the inferior meatus. Invariably with free pus present, it made its way out by the natural ostium to the nasopharynx within 10 minutes — often in a shorter time. A number of antra were injected with powder a few minutes before a radical antrotomy and the spiral streaming noted.

In chronic sinusitis with pus draining downward from the posterior ethmoids, powder blown into the superior meatus made its appearance at the Eustachian tube level in about eight to 10 minutes.

A great many cases from which polypi had been removed repeatedly were examined. When rudimentary, fibrous polypi were present in the middle meatus bathed in free pus, it was interesting to note the progress to the nasopharynx. With adequate drainage, powder was carried by the pus from the



Fig. 6. The arrows in the left antrum indicate the direction of ciliary streaming toward the ostium.

middle meatus to the nasopharynx in 10 to 12 minutes; however, over the surface of the polyp roots powder remained for an hour or two. Evidently islands of normal ciliated epithelium carried the pus away from the middle meatus, but it remained

on the nonciliated squamous surface of the immature poly-poid tissue until removed by traction.

Infections in the sphenoid alone are much less frequent than any of the other sinuses, nevertheless they occur in perhaps 4 to 6 per cent of all cases of sinusitis. A few cases of chronic sphenoiditis with free pus streaming from the ostium after anesthetizing and shrinking the anterior part of the nose were studied. Powder injected into the sphenoid mixed freely with the pus and flowed down posteriorly to the Eustachian tube and appeared at the level of the soft palate often in five minutes.

A few remarks should be made about the effect of smoking on ciliary activity. Very few references are to be found in the literature and personal communications from a number of investigators elicited little information.^{3,16,20-26} It is well known that even in moderation smoking and alcohol cause a mild reddening of the nasal and nasopharyngeal mucous membrane. If carried to excess, this congestion becomes chronic. This low grade chronic inflammation by itself does not appear to interfere with ciliary action, as powder placed in the active area of the nose shows in the nasopharynx in the average case in 10 or 12 minutes; however, in a smoky atmosphere, the mucous membrane becomes parched and dry, and when nasopharyngitis is present the action of the cilia is hindered. Many of these cases showed delayed action, the powder requiring often 15 minutes or more before appearing below the soft palate. The thick, tenacious mucus that requires removal from the nasopharynx in the morning after excessive smoking, and perhaps alcohol, is evidence of delayed ciliary activity. When congestion in the nose causes nasal obstruction, there is also a tendency to mouth breathing which aggravates the dryness and further embarrasses the action of the cilia. "The effect of smoke also appears to be caused by the atmosphere, *i.e.*, other persons' cigarette smoke rather than by the smoke taken into the mouth, if not inhaled. The so-called inflammation of the mucosa caused by smoking is not actually present, for there are no phagocytes in the secretion and these are always present in states of inflammation. It is rather a result of

chronic irritation. There are two forms, the one in which the mucosa is hypersensitive to smoke, in which eosinophiles are commonly present, and the other in which the subject is not allergic to smoke. The latter gives constant symptoms; the former, intermittent symptoms of greater severity. Other causes of local allergy in the throat may duplicate the picture."²⁶ It might be well before concluding to point out the fact that many careful investigators, such as Morton,²⁷ are convinced that upper respiratory infections are much more common in smokers than in nonsmokers; however, as yet this has not been demonstrated experimentally. According to Wilson and Stern,²⁸ "Most authors agree that locally tobacco has an irritating and injurious effect on the mucosa of the respiratory tract, which shows extensive deposits of tar and tar products at necropsy. Clinicians find that smokers have more colds and sinus trouble and that these last longer than those of the nonsmoker, and the 'cigarette cough' and the chronic pharyngitis of smokers are common knowledge."

It is difficult at present to deduce any practical points from these clinical findings. Although our knowledge today of nasal physiology is much greater than it was even a generation ago, our treatment in many of these conditions is still not entirely satisfactory; however, a thorough understanding of the nasal cilia and the normal and abnormal pathways through the nose would appear to be the very foundation of future treatment.

BIBLIOGRAPHY.

1. ASSHETON, R. (1896): Notes on the Ciliation of the Estoderm of the Amphibian Embryo. *Quar. Jour. Micr. Sci.*, 38:465.
2. GRAY, J. (1928): Ciliary Movement. London: Cambridge University Press, p. 17.
3. GRAY, J. (1922): *Proc. Roy. Soc.*, 93B:104.
4. CARTER, G. S. (1924): *Proc. Roy. Soc.*, 96B:115.
5. LUCAS, A., in COWDREY, E. V.: Special Cytology. 2nd Ed., Hoeber, 1932.
6. SHARPEY, W.: On a Peculiar Motion Excited in Fluids by the Surfaces of Certain Animals. *Edinburgh Med. and Surg. Jour.*, 34, 1830.
7. PURKINGE, J. E., and VALENTIN, G.: Entdeckung continerlicher durch Wimperhaare erzeugter Flimmerbewegungen, Muller: *Arch. f. Anat.*, 1834.
8. HILDING, A. C.: The Physiology of Drainage on Nasal Mucus.

- III. Experimental Work on the Accessory Sinuses. *Am. Jour. Physiol.*, 100:664, 1932.
9. LIEBLE, D. M., and MOORE, P. M.: Effect of Drugs on Ciliary Activity of Mucosa of Upper Respiratory Tract. *Arch. Otolaryngol.*, 19:55, 1934.
 10. GRAY, J. (1923): *Proc. Roy. Soc.*, 95B:6.
 11. NEGUS, V. E.: The Action of Cilia and the Effect of Drugs on the Ciliary Activity. *Jour. Laryngol. and Otol.*, 49:571, 1934.
 12. TWEEDIE, A. R.: Nasal Flora and Reaction of Nasal Mucus. *Jour. Laryngol. and Otol.*, 49:586, 1934.
 13. YATES, A. L.: Methods of Estimating the Activity of the Ciliary Epithelium within the Sinuses. *Jour. Laryngol. and Otol.*, 39:554, 1924.
 14. HILDING, A. C.: Experimental Surgery of the Nose and Sinuses. I. Changes in the Morphology of the Epithelium Following Variations in Ventilation. *Arch. Otolaryngol.*, 16:9, 1932.
 15. YATES, A. L.: Personal communication.
 16. LIEBLE, D. M.: Personal communication.
 17. FLETCHER, R.: *Calif. and West. Med.*, 55:94, 1941.
 18. TREMBLE, G. E., and SMITH, F.: Nasal Medication in Sinusitis. *Canad. Med. Assn. Jour.*, 53:564, Dec., 1945.
 19. FABRICANT, N. D.; HOLLANDER, A. R., and ANDERSON, H. W.: Effects of Various Solutions of Penicillin Sodium and Penicillin Calcium on the Respiratory Nasal Mucosa of Rabbits. *Arch. Otolaryngol.*, 46:1, July, 1947.
 20. PROETZ, A. W.: Personal communication.
 21. HILDING, A. C.: Personal communication.
 22. VAN ALYEA, O. E.: Personal communication.
 23. SCHALL, L. A.: Personal communication.
 24. WALSH, T. E.: Personal communication.
 25. GRAY, J.: Personal communication.
 26. YATES, A. L.: Personal communication.
 27. MORTON, H. J. R.: Tobacco Smoking and Pulmonary Complications After Operation. *Lancet*, 246:368, 1944.
 28. WILSON, G. E., and STERN, W. K.: Survey of the Literature on Tuberculosis. *Arch. Otolaryngol.*, 46:73-110, July, 1947.

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The Home Study Courses sponsored by the American Academy of Ophthalmology and Otolaryngology, in the basic sciences related to these two specialties, will be given again, beginning Sept. 1, 1948. Registrations must be completed before Aug. 15. Detailed information may be secured from Dr. William L. Benedict, Executive Secretary, 100 First Avenue Building, Rochester, Minn.

THE USE OF CONTACT THERAPY IN THE TREATMENT OF CARCINOMA OF THE LARYNX.*

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The employment of short distance low Roentgen therapy, or contact therapy, as a new adjunct in the treatment of selected cases of carcinoma of the larynx is offered for evaluation. Since April, 1946, we have employed contact therapy in conjunction with laryngofissure in the treatment of nine cases of fairly advanced intrinsic carcinoma of the larynx. These cases, with one exception, fell into the category of lesions in which laryngectomy or massive external irradiation has been considered advisable. Contact therapy was instituted because of contraindications to the more extensive operative procedure or patient's refusal to undergo such a radical operation.

The object of contact therapy in the treatment of intrinsic carcinoma of the larynx is to deliver to the base of the excised tumor a cancericidal dose of X-rays and at the same time damage as little as possible the underlying healthy tissue. A single caustic destructive dose is delivered to the tumor bed exposed at laryngofissure.

Most statistical reports indicate a five-year cure in approximately 80 per cent of the early cases of carcinoma of the larynx amenable to treatment by surgical excision at laryngofissure. A group representing 20 per cent, therefore, remains to be conquered. Treatment results are much less impressive in the more advanced cases which remain intrinsic but require either radical surgery or intense external radiation. Five-year cures in this category are less than 35 per cent. Any new method of approach which gives hope of salvaging even a small percentage of the unsuccessful cases deserves a thorough trial.

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Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, Feb. 9, 1948.

PHYSICAL ASPECTS OF CONTACT THERAPY.

Contact therapy was instituted by Chaoul and Adam, in 1931, in an attempt to use low voltage radiation as a substitute for radium (see Fig. 1) in the treatment of malignant disease. They believed that the effect of radiant energy depended upon the total energy absorbed per cubic centimeter

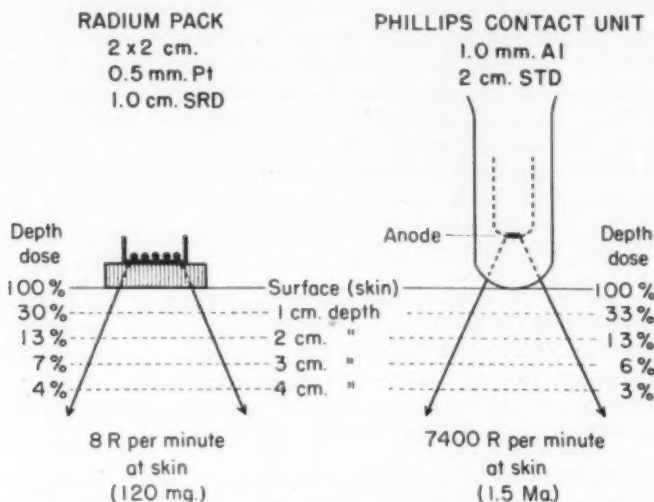


Fig. 1. Comparison of radiation depth dose and radiation intensity of radium and of the low voltage contact therapy tube.

of tissue and the fractionation of that total energy rather than upon its wave length. They accomplished their objective by the use of a short focal skin distance and a low voltage which resulted in confining the radiation effect to a small volume of tissue.

There are currently available several types of special apparatus which fulfill the basic requirements of the Chaoul-Adam thesis; *i.e.*, short anode-surface distance, low inherent filter, soft radiation and small field of irradiation. Our machine is of a design which makes the irradiation of intrinsic carcinoma of the larynx a quick, practicable and so far satisfactory

procedure. The small X-ray tube of the unit permits ready insertion of the radiation source directly into the incised larynx and administration of a cancericidal dose of Roentgen rays in a very short time. The tube is cylindrical in shape

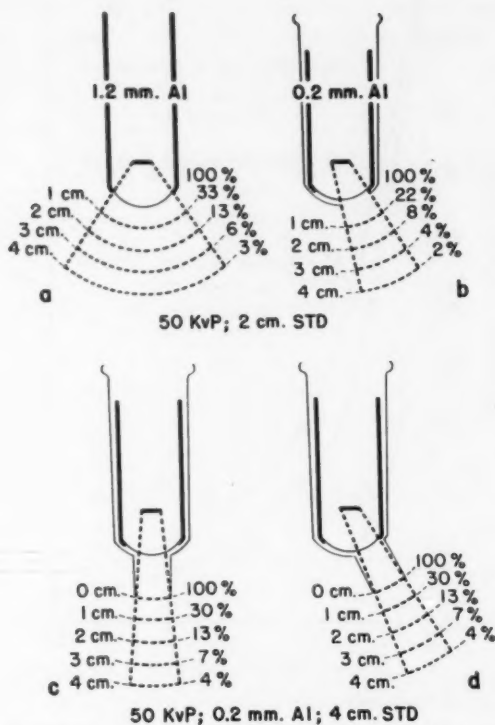


Fig. 2. Contact therapy depth dose charts for various filters, cones and skin target distances.

and is 23.7 inches long. The portal is 1.2 inches in diameter. The X-ray tube and control are shielded completely by grounded metal housings, and a shockproof flexible high-tension cable connects tube and generator. While the machine itself is free from danger of electrical shock to the patient

and operator, it would not be safe to operate in the presence of gaseous anesthetics of an explosive type.

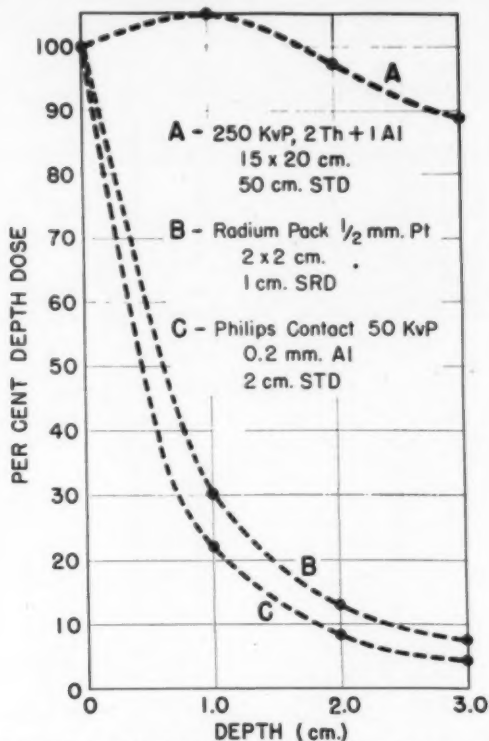


Fig. 3. Comparison of depth dose from deep X-ray therapy, radium therapy and contact therapy, respectively.

The unit is mobile and can be wheeled about easily from room to room. The X-ray tube is mounted on well balanced and adjustable supporting arms, and can be pointed and locked in any direction. In the treatment of tumors through surgical incisions the tube is directed best by removal from its supports and held in the hands of the operator.

The equipment we use operates at one kilovoltage, namely,

50 KvP constant potential. Its inherent filter is equivalent to 0.2 mm. Al: its anode is 2.0 cm. from the window of the tube; thus, contact application actually represents minimum anode-surface distance of 2.0 cm. This is with the plastic exit window of the tube head against the tissues. Radiation may be accurately localized to specific areas by means of interchangeable cones selected for various conditions of field size and anode-surface distances (see Fig. 2). Extra filters of 1.0 mm. Al or 2.5 mm. Al can be added.

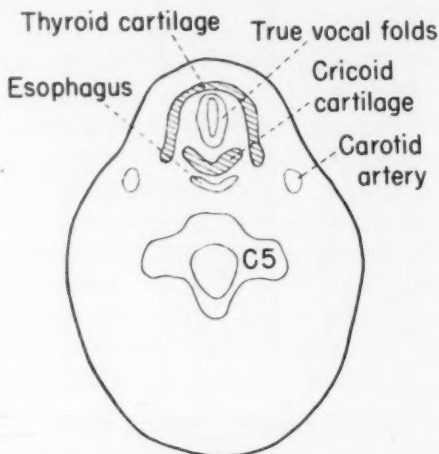


Fig. 4. Cross-sectional diagram of the neck at the level of the true cords.

The intensity of radiation emitted by our contact unit is 7,400 Roentgens per minute with no added filter, anode-surface distance of 2.0 cm. and 1.5 milliamperes of tube current. One mm. Al reduces the intensity to 740 Roentgens per minute; 2.5 mm. Al reduces it to 370 Roentgens per minute. The high intensity of radiation makes possible the administration of large doses in a few seconds or minutes: a fact which is particularly advantageous in the treatment of patients in the operating room following surgical exposure of tumors.

The problem of radiation protection is minor compared to conventional X-ray therapy. Radiations are emitted only from the portal end of the tube; moreover, scattered rays are minimal owing to the small volume of irradiated tissue and to the low penetration of the rays. It must be emphasized, however, that radiation protection cannot be ignored completely. Tests

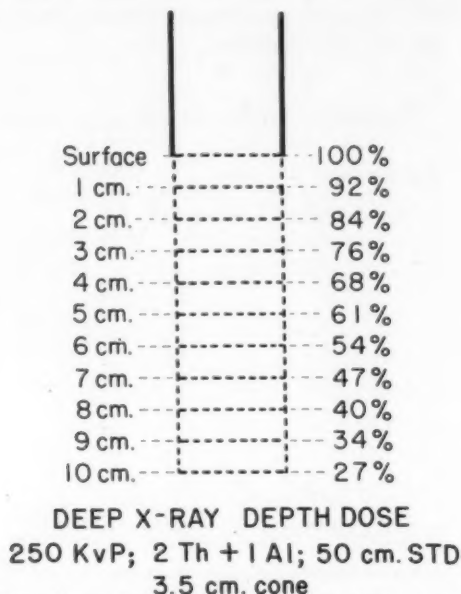
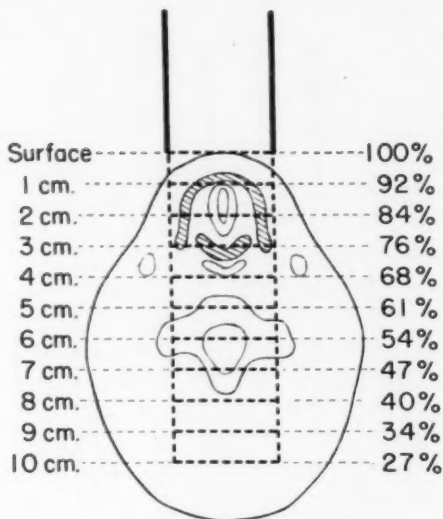


Fig. 5. External deep X-ray therapy depth dose chart. (Per cent of depth dose refers to the center of the radiation beam. Falling-off of dose near the periphery is not indicated.)

of lateral scattering of X-rays from a paraffin phantom indicated the need of some protection. The intensity of scattered X-rays two feet from the center of a paraffin phantom approximately the size and shape of an adult head was less than 0.02 Roentgens per minute. Assuming a tolerance dose of 0.2 r per day, personnel handling the machine should wear leaded aprons or stand behind lead screens if they are required to be less than two feet from the tube for actual operating

times of 10 minutes or more per day. The total operating time of our unit has seldom exceeded five minutes per day, even though several patients were treated. Lead gloves should be worn by the operator if his hands are near the exit port of the tube.



DEEP X-RAY DEPTH DOSE
250 KvP; 2 Th + 1 Al; 50 cm. STD
3.5 cm. cone

Fig. 6. Superimposition of external deep X-ray depth dose chart and cross-sectional diagram of the neck. Anterior port.

Contact therapy has a number of advantages over conventional external irradiation in the treatment of small tumors. The radiation effect can be limited to the tumor and its immediate vicinity, both laterally and in depth. The absorption is such that the depth dose falls off rapidly as compared to deep X-ray therapy (see Fig. 3). Skin tolerance, since no skin surface is penetrated, is not a problem and overdosage to small volumes of tissue, all of which may be tumor, does not

produce serious complications as sometimes result from deep X-ray therapy. It has been our experience that normal tissue will tolerate radiation of this quality to a far greater extent than is the case with high voltage radiation. Since insignificant damage is done to surrounding tissues, contact therapy produces minimal late deformity. It should be emphasized

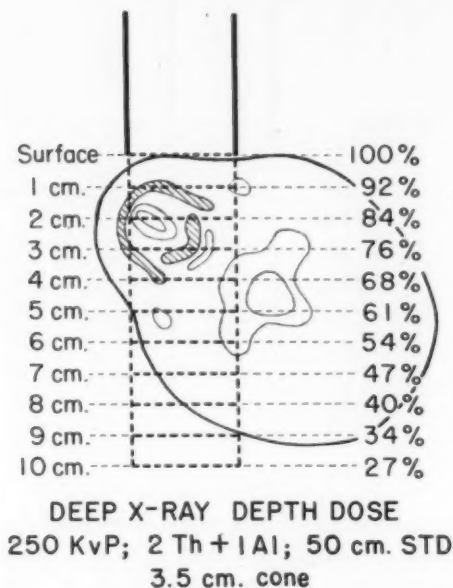
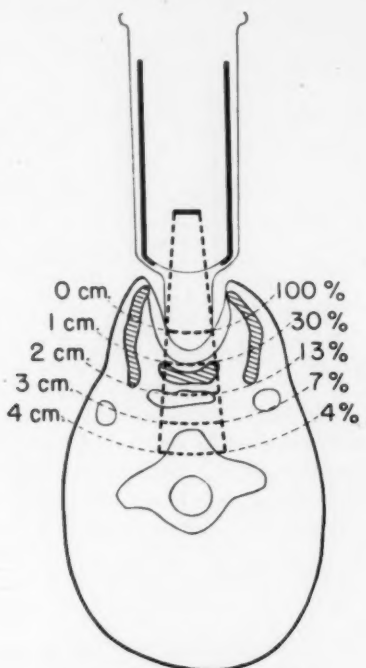


Fig. 7. Superimposition of external deep X-ray depth dose chart and cross-sectional diagram of the neck. Right lateral port.

that contact therapy's chief advantage, that is, low depth dose, may become its chief weakness if not used judiciously. Depth of tumor must be estimated as accurately as possible. If it appears to exceed 1.0 cm., then reliance upon contact therapy alone may result in failure. A cancericidal dose can be applied much more rapidly than with either external irradiation or radium. This is particularly advantageous when combining irradiation with any surgical procedure.

Depth dose of radiation to tumors of the larynx, and also to adjacent structures of the neck are found by superimposition of cross-sectional diagrams of the neck (see Fig. 4) and depth dose charts such as those in Figs. 2 and 5. The par-



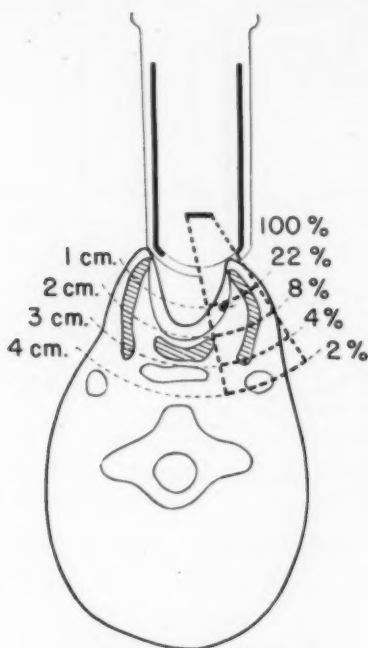
CONTACT THERAPY

50 KvP; 0.2 mm. Al; 4 cm. STD

Fig. 8. Superimposition of contact therapy depth dose chart and cross-sectional diagram of the neck. A 1.5 cm. cone is projected against the posterior wall of the opened larynx.

ticular diagram of the neck shown here was obtained from a section of a cadaver of average size and at the level of the true vocal cords. The method of depth dose determination is demonstrated in Figs. 6 and 7 for external deep X-ray therapy

when the larynx is exposed to a 3.5 cm. beam of radiation directed alternately through an anterior right lateral and left lateral port. The administration of contact therapy to the opened larynx is demonstrated diagrammatically in Figs. 8, 9 and 10.



CONTACT THERAPY
50 KvP, 0.2 mm. Al; 2 cm. STD

Fig. 9. Superimposition of contact therapy depth dose chart and cross-sectional diagram of the neck. Treatment of the right anterior commissure and cord with "contact" cone.

The experimental fact that contact therapy does insignificant damage to normal tissues surrounding the larynx as compared to the frequent complications and unpleasant reactions of deep external therapy is explained on the basis of

distribution of radiation in the two techniques of treatment (see Table 1).

TABLE 1. ROENTGEN DOSAGE IN RADIATION THERAPY OF THE LARYNX.

Anatomical Parts	Therapy Techniques	
	Deep Therapy— Small Fields: 200 KvP: ½ mm. Cu and 1 mm Al: 50 cm. STD: 3.5 cm. Cone Three Fields	Contact Therapy— One Field: 50 KvP: 0.2 mm Al: 4 cm. STD: 1.5 cm. Cone
True Cord—Posterior.....	5,000 r	5,000 r
Cricoid Cartilage— Posterior.....	4,800 r	1,500 r
Esophagus.....	4,200 r	650 r
Carotid Artery.....	3,000 r	Negligible
Cervical Vertebra.....	3,500 r	Negligible
Skin.....	3,000 r	Negligible

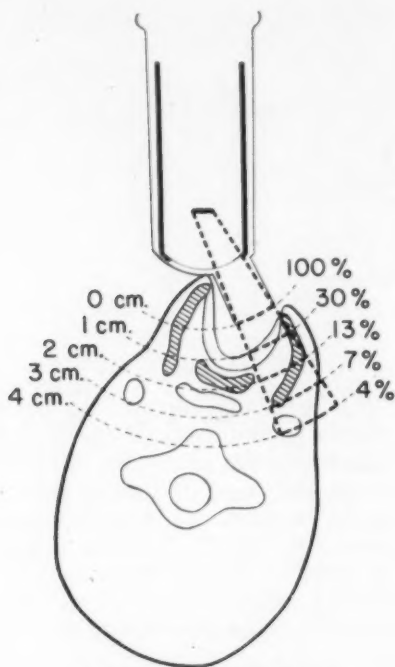
MATERIAL.

Since April, 1946, when this method was first applied, nine patients with intrinsic carcinoma of the larynx have been selected as candidates for this procedure. All of these patients had large growths and were considered from the surgical viewpoint as logical candidates for total laryngectomy. Some were poor surgical risks for the extensive procedure because of complicating systemic disease. The remainder refused to accept the mutilating result of laryngectomy but were willing to submit to this less radical approach of laryngofissure plus contact therapy.

The neoplasm in each of these patients, although advanced, was considered to be resectable by the laryngofissure approach if the residual tumor bed and adjacent tissue margins could be treated adequately to sterilize any residual neoplastic cells and provide adequate protection against recurrence. Each of the patients was made aware of the fact that laryngofissure with combined contact therapy might prove unsuccessful with resultant recurrence of the tumor which would necessitate total laryngectomy or heavy external irradiation.

Up to the present time all small carcinomas of the larynx which could be resected with a safe margin of normal tissue

have been operated by the classical laryngofissure technique without the use of contact therapy.



CONTACT THERAPY
50 KvP, 0.2 mm. Al; 4 cm. STD

Fig. 10. Superimposition of contact therapy depth dose chart and cross-sectional diagram of the neck. Treatment of the right anterior half of a cord with 1.5 cm. cone.

METHOD.

In each of the nine cases in this series exposure of the neoplasm was made by the laryngofissure technique. An analysis of the extent of the lesion was made. The lateral extension as well as the depth of infiltration was estimated as accurately as possible, so that adequate Roentgen dosage

could be calculated and the projections planned. In each instance as much tumor tissue as possible was removed without mutilating the entire larynx. As soon as satisfactory hemostasis was accomplished, irradiation by the contact method was applied to the bed of the tumor. The tube was placed directly into the larynx with proper cone selected to meet the requirements of the area to be included in the radiation field. One field of irradiation was used for the smaller lesions, while multiple fields were employed for the more extensive tumors. In one case where growth had occurred across the anterior commissure a field through the approximated halves of the laryngeal cartilage was used.

A single caustic dose of Roentgen therapy was given. The dosage in these cases varied from 5,000 r to 12,000 r. Total doses larger than the latter figure should be considered; however, we have proceeded cautiously in employing a method in which absolute tissue tolerance levels are not well established.

Tracheotomy was not employed in any of these cases. Closure was carried on in the usual manner. The patients were observed carefully postoperatively for any evidence of bleeding or obstructive edema.

SEQUELAE.

Reactions to contact therapy within the larynx are less severe than in cases treated by deep X-ray therapy applied externally, or by radium therapy. Only a mild hyperemia of the mucosa adjacent to the operative site was observed in postoperative laryngeal examination. There were no cases in which edema was of sufficient degree to cause any alarm.

In one instance postoperative bleeding occurred. This was attributed to struggling after the anesthesia. This necessitated reopening of the larynx, packing, and insertion of a small tracheotomy tube for 24 hours.

Sequestration of the laryngeal cartilage occurred in two cases. In one of these, radiation had been applied through the approximated halves of the laryngeal cartilage, and the other

was treated with external deep therapy subsequent to the primary procedure.

Secondary laryngoscopy was employed in instances where granulation tissue developed and recurrence was suspected. Tissue was removed from questionable areas in five cases. One of these showed definite evidence of recurrence and a total laryngectomy was carried out.

Discharging external fistulae occurred in four cases, including the two in which sequestration of small bits of cartilage took place. All four closed spontaneously in from one to six months.

All patients developed a web in the region of the anterior commissure, as observed on follow-up studies. Voice quality ranged from moderate to severe huskiness.

No other significant sequelae have yet been detected. All cases are under careful observation.

RESULTS.

Of the nine cases of fairly advanced intrinsic carcinoma of the larynx, there was recurrence in one case. This was detected on biopsy four and one-half months following the primary procedure.

The remaining eight cases have remained free of visible evidence of recurrence for periods up to 21 months. These patients are well at present. Hoarseness persists in all but not of sufficient degree to produce any serious handicap.

No attempt is made to further evaluate our results, as we are fully cognizant of the possibilities that still exist for recurrence. Only a five-year period will produce a partially correct evaluation and comparison with other methods of treatment of this category of cases of carcinoma of the larynx.

CASE REPORTS.

Case 1: C. O., age 44, white male. Hoarseness, two months. Laryngoscopy, April 12, 1946, revealed carcinoma of the posterior two-thirds of the right vocal cord. Arytenoid cartilage freely movable. Laryngofissure

and contact therapy, April 23, 1946. At operation the tumor extended from the anterior commissure to the tip of the vocal process of the arytenoid cartilage on the right. The laryngeal ventricle and the subglottic area were normal. The entire right vocal cord was removed, including the vocal process of the arytenoid. Very little normal mucosa was included in the excised portion. Small bits of tissue were removed from the anterior surface of the arytenoid cartilage after the excision of the right vocal cord. These fragments showed residual carcinoma on subsequent microscopic examination. The bed of the right vocal cord was irradiated with a total of 7,500 r of contact therapy (50 KvP, 0.2 mm. Al, 4.0 cm. STD, 2.0 cm. field).

Histological Report: Squamous cell carcinoma of the larynx, grade I to II.

Laryngoscopy was repeated on May 20, 1946. Healing was well advanced, with a cicatricial band replacing the removed vocal cord. Small granulations were removed from several areas about the operative field. These on microscopic examination showed no evidence of recurrence. Examination in December, 1947 (indirect laryngoscopy) showed no evidence of recurrence.

Case 2: C. K., age 73, white male. Diabetic and cardiac. Hoarseness of three months' duration. Laryngoscopy, Aug. 12, 1946, revealed carcinoma involving the anterior half of the left vocal cord and extending for 2.0 to 3.0 mm. onto the anterior end of the right vocal cord. Laryngofissure performed Aug. 21, 1946. The anterior two-thirds of the left vocal cord and the anterior one-third of the right vocal cord were removed. The surgical specimen included 3.0 to 4.0 mm. of normal tissue around the tumor. The divided laryngeal cartilage was allowed to fall together and 5,000 r (50 KvP, 1.2 mm. Al, 2.0 STD, 2.0 cm. field) of contact therapy was delivered directly to the anterior surface of the laryngeal cartilage, the skin and soft tissues being retracted laterally.

Histological Report: Squamous cell carcinoma, grade I to II.

Direct laryngoscopy was performed Sept. 23, 1946. A moderate degree of laryngeal edema was observed. Biopsies were removed from the edematous mucosa in the anterior commissure; these showed no evidence of carcinoma. The external incision (laryngofissure) developed a small discharging fistula through which small sequestra were extruded at intervals. The fistula healed spontaneously by the end of the third post-operative month. Laryngoscopy was repeated Jan. 15, 1947 and biopsies removed from both vocal cords, false cord areas and epiglottis. These proved negative for recurrence on microscopic examination. Subsequent indirect laryngoscopy on Nov. 12, 1947, showed no evidence of recurrence.

Case 3: G. S., age 62, white male. Hoarseness for two to three years. Direct laryngoscopy and biopsy, Sept. 3, 1946, demonstrated a carcinoma of the right vocal cord extending from the anterior commissure to the tip of the vocal process of the arytenoid cartilage. Laryngofissure performed Sept. 7, 1946. The tumor extended subglottically to within 2 mm. of the cricothyroid membrane. It had crossed the anterior commissure to involve the anterior 2.0 mm. of the left vocal cord. The resected tumor included 1.0 to 2.0 mm. of normal mucosa around it. The anterior one-fourth of the left vocal cord and all of the right cord were removed, including the vocal process of the arytenoid cartilage. After removal of the tumor mass, bits of tissue were removed from several areas of the remaining bed; these on pathological examination failed to show any evidence of carcinoma. The bed of the tumor was irradiated with 5,000 r (50 KvP, 0.2 mm. Al, 2.0 STD, 3.0 cm. field) of contact therapy.

Histological Report: Squamous cell carcinoma, grade II to III.

A postoperative discharging fistula persisted in the incision until Oct. 3, 1946. Because of the size of the original tumor the patient was given external irradiation between Sept. 11, 1946, and Oct. 26, 1946. The interior of the larynx received 2,800 r (250 KvP, 2.0 mm. Th plus 1.0 mm. Al, 10 x 10 cm. field, 50 cm. STD), given through two 10 x 10 cm. fields, one right lateral and one left lateral. Laryngoscopy and biopsy were performed Nov. 2, 1946, and Jan. 24, 1947. Granulations removed on these two occasions failed to show recurrence of carcinoma. Indirect laryngoscopy in December, 1947, showed no evidence of carcinoma. A cicatricial web was observed in the anterior commissure and hoarseness was rather severe.

Case 4: M. U., age 64, white male. Hoarseness of nine months' duration. Laryngoscopy and biopsy Nov. 12, 1946, revealed a carcinoma extending from the anterior commissure to the body of the arytenoid cartilage on the right side. Laryngofissure Nov. 20, 1946. The entire right vocal cord and arytenoid cartilage were removed. Contact therapy, 5,000 r (50 KvP, 0.2 mm. Al, 4.0 STD, 2.0 cm. field), was applied to the bed of the tumor.

Histological Report: Squamous cell carcinoma, grade III.

An external fistula persisted postoperatively and drainage was profuse. Between Jan. 6, 1947, and Feb. 6, 1947, the patient received in addition 5,600 r (skin dose) (250 KvP, 2.0 mm. Th plus 1.0 mm Al, 50 cm. STD, three fields, each 7 x 8 cm.: right and left lateral and anterior) of deep X-ray therapy. A severe perichondritis of the laryngeal cartilage developed with dysphagia and dyspnea which necessitated hospitalization from Feb. 27, 1947 to March 12, 1947. This responded well to intensive penicillin therapy. The external fistula persisted until April 29, 1947, when it closed spontaneously after a sequestrum of cartilage extruded through it. The postoperative course thereafter was uneventful. The last examination on Dec. 17, 1947, showed no evidence of recurrence on indirect laryngoscopy. A cicatricial web (4 mm.) occupied the anterior commissure and the quality of the voice was very husky.

Case 5: J. G., age 67, white male, cardiac. Hoarseness for six months. Laryngoscopy and biopsy April 5, 1947, showed a new growth involving the middle one-half of the left vocal cord. Laryngofissure April 11, 1947. The tumor was confined to the vocal cord beginning at a point 5 mm. behind the anterior commissure and ending at the tip of the arytenoid cartilage. The tumor was excised surgically along with 1.0 to 2.0 mm. of normal tissue surrounding it. The bed of the tumor received 5,000 r (50 KvP, 0.2 mm. Al, 4.0 cm. STD, 3.0 cm. field) of contact therapy. This was delivered through two ports: The first was with the treatment cone in the larynx, at which time 3,125 r was given; the second was with the cone out of the larynx and the laryngeal cartilages approximated. The surface dose of this second port was 12,500 r, which gave an estimated 1,875 r at the tumor bed. A prelaryngeal lymph node was removed at operation.

Histological Report: 1. Squamous cell carcinoma of the larynx, grade I. 2. Normal lymph node.

A suppurating fistula persisted at the lower end of the incision until June 9, 1947, when it closed spontaneously. Indirect laryngoscope Dec. 19, 1947, showed no evidence of recurrence. The voice was rather husky and a small web (3.0 mm.) was observed in the anterior commissure.

Case 6: T. M., age 57, white male. Hoarseness for one year. Laryngoscopy and biopsy April 22, 1947, revealed a large carcinoma involving the entire right vocal cord, from the vocal process of the arytenoid cartilage to the anterior commissure. Laryngofissure and contact therapy April 23,

1947. The growth was excised from the anterior commissure to the body of the arytenoid cartilage on the right side. Bits of tissue were removed from various portions of the tumor bed which showed residual carcinoma on subsequent histological examination. The bed of the tumor was treated with 5,000 r (50 KvP, 0.2 mm. Al, 4.0 STD, 2.0 cm. field) of contact therapy, with the two halves of the laryngeal cartilage being separated to admit the tube.

Histological Report: Squamous cell carcinoma, grade II to III.

Laryngoscopy and biopsy on Sept. 4, 1947, showed a recurrent carcinoma involving the anterior one-fourth of the larynx on each side (intrinsic). Laryngectomy was performed Sept. 16, 1947. Histological examination showed considerable leucocytic infiltration about the recurrent carcinoma and vascular changes compatible with irradiation.

Case 7: F. W., age 47, white male. Hoarseness for two years. Laryngoscopy April 23, 1947, showed carcinoma involving the anterior two-thirds of the left vocal cord. The right vocal cord had undergone a diffuse polypoid degeneration, confirmed by biopsy. Laryngofissure April 28, 1947. The tumor involved both surfaces of the left vocal cord from the anterior commissure to the vocal process of the arytenoid cartilage. It was excised with a minimal amount of normal tissue surrounding it. Bits of tissue removed from the bed of the tumor did not reveal residual carcinoma on subsequent examination. Contact therapy, 5,000 r (50 KvP, 0.2 mm. Al, 4.0 cm. STD, 1.0 cm. field), was delivered to the bed of the tumor.

Histological Report: Squamous cell carcinoma, grade II.

The external incision was completely healed by May 19, 1947. The course thereafter was uneventful and on Dec. 6, 1947, there was no evidence of recurrence. A cicatricial fibrous web (4 mm.) occupied the anterior commissure and the voice was rather husky.

Case 8: A. M., age 57, white male. Hoarseness, four months. Laryngoscopy and biopsy July 11, 1947, revealed a large polypoid mass occupying the whole length of the left vocal cord. Histological examination revealed a carcinoma. The patient, a Mohammedan, fasted for two months before submitting to laryngofissure on Sept. 18, 1947. Both vocal cords showed a diffuse hyperplasia which was most pronounced on the left. The entire left vocal cord was removed down to the vocal process of the arytenoid. Bits of tissue removed from the bed of the left vocal cord and from the surface of the right cord subsequently showed no evidence of residual carcinoma. The intact anterior two-thirds of the right vocal cord was treated with 5,000 r (50 KvP, 0.2 mm. Al, 4.0 cm. STD, 1.0 cm. field) of contact therapy, and another 5,000 r (50KvP, 0.2 mm. Al, 4.0 STD, 1.0 cm. field) was delivered to the anterior two-thirds of the bed of the left vocal cord.

Histological Report: Squamous cell carcinoma, grade II to III.

The postoperative course was uneventful, the patient returning to work on Oct. 9, 1947. Subsequent examination Dec. 23, 1947, showed complete healing with cicatricial web.

Case 9: F. L., age 52, white male. Hoarseness for three years. Laryngoscopy Sept. 19, 1947, showed a diffuse hyperplasia of the mucosa of both vocal cords. The anterior one-third of the left vocal cord was granular and hyperplastic, and biopsy studies from this tissue showed carcinoma. Laryngofissure Oct. 1, 1947. The entire left vocal cord was removed, including the vocal process of the arytenoid cartilage. Biopsies were removed from the surface of the left arytenoid cartilage and from the right vocal cord. Thorough examination of all tissues removed at

laryngofissure failed to show any evidence of carcinoma. The assumption was that tissue removed at biopsy probably included all of the carcinoma. At the time of laryngofissure 7,000 r (50 KvP, 0.2 mm. Al, 4.0 cm. STD, 1.0 cm. field) was delivered to the anterior one-third of the right vocal cord, and 5,000 r to the anterior two-thirds of the left vocal cord.

Histological Report: Squamous cell carcinoma, grade II to III.

Six hours later, postoperative bleeding occurred, necessitating reopening of the larynx, insertion of a small tracheotomy tube into the larynx and packing of the interior of the larynx. The packing and tracheotomy tube were removed in 24 hours. The wound had completely healed by Oct. 19, 1947. Laryngoscopy was repeated Dec. 12, 1947, for removal of granulations. There was no evidence of recurrence on microscopic examination of the tissue removed.

SUMMARY.

Nine cases of carcinoma of the larynx were treated by a combination of surgical excision at laryngofissure and contact therapy of the bed of the tumor. All were men varying from 44 to 73 years of age. Duration of hoarseness varied from two months to three years. All of these tumors were large but intrinsic in the larynx. Because of their size there was a question whether or not the tumors could be completely removed by a simple laryngofissure operation. In two of the nine cases residual carcinoma was found in bits of tissue removed from the bed of the tumor at the time of its excision, and in one of these the carcinoma recurred in the anterior commissure in spite of the contact therapy. In retrospect, we believe that this might have been avoided had we applied contact therapy directly through the approximated halves of the laryngeal cartilage or if we had used an angulated cone applied to the interior so as to treat adequately the anterior commissure. We did not have the courage to apply contact therapy directly through the laryngeal cartilage once we discovered a recurrence, although we entertained that possibility.

Two of our larger tumors (Cases 3 and 4), in which laryngectomy was refused by the patient, were given deep X-ray therapy in addition to contact therapy. One case (Case 4) developed a severe perichondritis and later sequestered a portion of the laryngeal cartilage. No untoward effects were observed from contact therapy aside from discharging external fistulas in four cases lasting from one to six months. All fistulas healed spontaneously, two of them after the expulsion

of sequestra. One patient developed postoperative bleeding which was attributed to struggling after anesthesia. The first case received a total of 7,500 r. The eighth case received a total of 10,000 r. The ninth case received 12,000 r. The remaining cases received 5,000 r. All cases healed with cicatricial webs in the anterior commissure and a resulting severe huskiness of voice.

CONCLUSIONS.

1. A new method of treating certain cases of carcinoma of the larynx is submitted; namely, the use of low voltage radiation therapy at extremely short anode-surface distance.

2. In view of the mutilating effects of total laryngectomy, any new method of attack to preserve the larynx deserves and should be given the most careful consideration and clinical trial.

3. Caustic doses of radiation therapy can theoretically be delivered to carcinoma of the larynx, with or without excision of the tumor, with a minimum degree of disturbance to the laryngeal physiology.

4. Caustic doses of X-ray therapy can be delivered in one treatment lasting only a few minutes at the time of laryngofissure.

5. The serious sequelae of deep X-ray therapy are minimized in the use of contact therapy.

6. Definite conclusions cannot be drawn as yet, due to the small number of cases treated and the short period of elapsed time after treatment.

7. With the use of contact therapy in addition to laryngofissure we hope to decrease the number of necessary total laryngectomies. With this technique we also hope to reduce the incidence of recurrence in that group of cases ordinarily treated by surgical excision at laryngofissure.

8. We eventually plan to use contact therapy alone without surgical excision in the treatment of superficial intrinsic carcinomas of the larynx following exposure at laryngofissure. In such cases better permanent voice may result.

WHEN IS A CASE OF CLINICAL OTOSCLEROSIS SUITABLE FOR FENESTRATION?*

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By suitability of a case of clinical otosclerosis for fenestration, I am referring to the possibility of restoring serviceable hearing for social and economic purposes, which according to experience is accompanied by a rise to the 30 db level or better, for the critical frequencies, 512, 1,024 and 2,048 dv.

This subject has been thoroughly and scientifically discussed by Lempert,^{1,2,3,4,5} Moorehead,⁶ House⁷ and others, and it is my purpose to repeat and emphasize much of what has been said, because I believe proper selectivity is one of the important factors which directly determines end results, and to point out certain features of the audiogram, the interpretation of which has been found to have some diagnostic significance in proper selection of cases for fenestration. As stated by Williams⁸ "it seems extremely important that all surgeons insist on the same clinical pattern in the selection of patients for operation so that results of operation can be evaluated more accurately, otherwise what may be a valuable surgical procedure may fall into disrepute because of its indiscriminate application in unsuitable cases."

For purposes of logical discussion, it is germane to state again that deafness resulting from otosclerosis is progressive and after a variable length of time eventuates in secondary nerve degeneration of the organ of Corti, and, as Lempert⁵ has succinctly stated, "there is no known satisfactory medical treatment which either improves the hearing or arrests the pathological process, and both experience and time have shown that in a large percentage of patients, clinical otosclerosis can be cured only by the fenestration operation."

*Read before the Ear, Nose and Throat Section of the New York Academy of Medicine, from the Ear, Nose and Throat service of the Mount Sinai Hospital, Jan. 21, 1948.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, Feb. 2, 1948.

Patients with clinical otosclerosis present themselves to the otologist at various stages of their hearing impairment. For practical purposes of my discussion ("When is a case of clinical otosclerosis suitable for fenestration?"), I would like to divide these patients into three groups:

Group 1: Patients with clinical otosclerosis about whom there is no question as to their suitability for the fenestration operation.

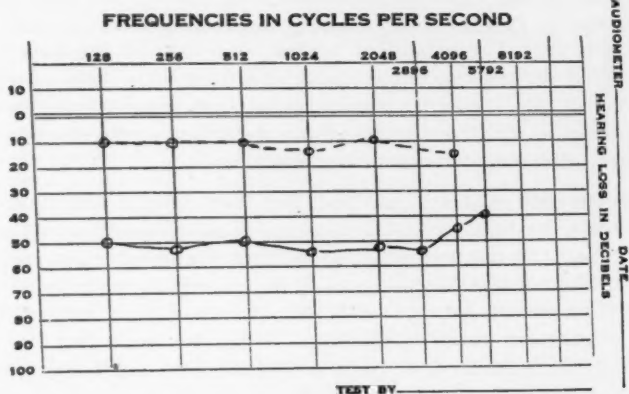


Fig. 1. Shows an ideal case from audiometric findings. It indicates a span or differential between air and bone conduction of more than 30 db for the critical frequencies with bone conduction curve not below the 30 db level.

The hearing in these patients has diminished to a level where it is no longer possible for them to hold the jobs at which, by training and inclination, they are best fitted. Tuning fork tests, repeated audiograms and whispered voice lead us to believe that there is good reservoir of cochlear nerve function still present, as stated by Lempert,⁵ "in excess of what is being utilized or tapped by the functionally impeded air conduction mechanism." Audiometric findings of the type in Fig. 1, when noted consistently in patients with normal or well healed tympanic membranes and patent Eustachian tubes, who have been carefully studied and found to have

clinical otosclerosis and who are free of serious general constitutional disease, are unquestionably suitable for fenestration. As a general rule, an ideal case may be termed as one in which there is a differential or span of 30 db between bone conduction and air conduction for the critical frequencies, providing the bone conduction findings are not below the 30 db level.

I stress the importance of estimating the emotional reactions of the patients to their deafness and the importance of psychiatric aid in those patients whose history and behavior lead one to suspect some inherent uncontrollable psychogenic disturbance. The reliability of the responses of the psychoneurotic, in testing, often taxes the diagnostic skill of the otologist. It is well to bear in mind that many of the mild psychologic maladjustments of the deaf frequently disappear after a successful fenestration operation.

When both ears are involved, and they usually are, in otosclerosis, so that practical hearing is not present in either ear, then the ear suspected of having the greater reservoir of cochlear nerve function should be chosen, even though the ear thus chosen is apparently the better one, as judged by air conduction curve comparison. When one feels that cochlear nerve function is equal in both ears, then the poorer ear, insofar as air conduction is concerned, should be chosen.

Group 2: Patients with clinical otosclerosis about whom there is no question as to their unsuitability for the fenestration operation.

The rationale for the cure of clinical otosclerosis, according to Lempert,⁵ is based on the by-passing of the otosclerotic lesion about the oval window with its resultant immobilization of the footplate of the stapes, and the making of a new window in the surgical dome of the vestibule, an area in which otosclerotic lesions have never thus far been observed. In some of the advanced cases of otosclerosis, in which there is stapedial fixation and a similar otosclerotic involvement about the round window membrane with resultant fixation, there is nothing to look forward to, insofar as restoration of func-

tion is concerned; therefore, this type of case must be regarded as unsuitable for operation. Unfortunately, it is not easy to clinically diagnose fixation of the round window membrane.

The type of audiogram depicted in Fig. 2 must be regarded as unsuitable for fenestration operation, according to our

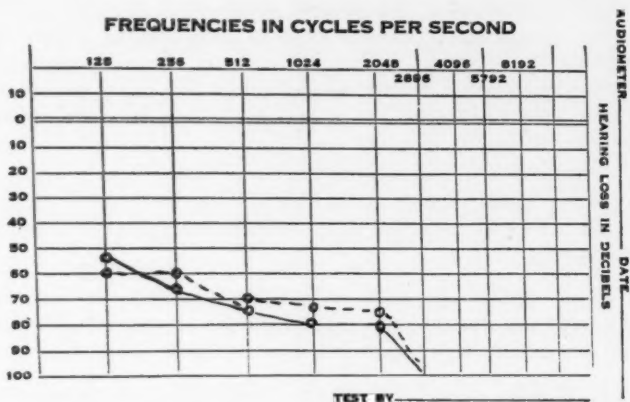


Fig. 2. Is the audiogram of an unsuitable case for fenestration. It does not show any span or differential between air or bone for the critical speech frequencies.

present knowledge. From clinical experience, we have learned that no matter how well a fenestration operation is performed on such patients, the possibility of restoring practical hearing is rather remote. The explanation offered is that there is little cochlear reserve function to draw upon, as evidenced by the type of bone conduction curve and the relation thereunto of the air conduction curve. I wish to reiterate the absolute necessity of the routine use of masking, particularly for reliable data in estimating bone conduction. Unfortunately, the masking devices in general use leave much to be desired.

Maxwell⁹ in a recent discussion of the selection of cases for the fenestration operation stated, "it is true that some cases have been reported in which serviceable hearing has been

restored by fenestration, although the audiograms indicated profound nerve deafness. These cases are rare and offer no justification to the otologist for operating on patients with evidence of cochlear damage in the hope there may be some improvement in hearing even though it will probably be below the serviceable level."

Definite contraindications to the performance of the fenestration operation are: perforated drums with or without middle ear suppuration; severe eczema and fungus infections involving the external auditory canal and drum membrane; active suppuration in the nasopharynx or nasal accessory sinuses; nerve deafness due to mumps, meningitis, etc.; blood dyscrasias; serious general constitutional or mental disease; active tuberculosis; severe nephritis or lues. Day¹⁰ believes that acute nasal allergy occurring within two months after operation was at least partially responsible for four failures in his series.

I do not believe patients with normal hearing in one ear and acceptable criteria for suitability for fenestration in the other ear should be subjected to operation.

It is of scant consolation to the unsuitable, poorly selected patient, to be shown an audiogram indicating an improvement from the 70 to the 50 db level and to be cheerfully told they are better, so long as they are not restored to serviceable hearing. According to Maxwell, "that economic pressure and the desire for wide surgical experience may become factors in poor selection of surgical cases can scarcely be doubted."

Group 3: Patients with clinical otosclerosis who present many problems and cause considerable concern to the otologist in deciding whether or not they are suitable for fenestration.

In this group there often is considerable variance of opinion as to suitability. This group has often been referred to as the "border line" group. It may be that with vast clinical experience, such as Lempert has, one may have fewer cases which will fall into this group. As stated before, the question of paramount importance that must be answered is, has the

prospective patient a sufficient reservoir of untapped or unused cochlear function, so that a properly performed operation will enable him to attain the 30 db level or better, and thus gain serviceable hearing? If this question cannot be answered in the affirmative, then there is little justification for surgery.

In 1936, the American Otological Society held a symposium on "Hearing by Bone Conduction" and I would like to quote the introductory note, "We know very little about hearing by bone conduction, but this symposium will be justified if it does nothing more than to arouse interest in the subject and to serve as a basis for future study and discussion." How does one attempt to determine whether or not the patient has a sufficient reservoir of cochlear nerve function? From the present state of our knowledge, it must be admitted that we do not as yet have at our command an accurate, completely reliable test which will indicate the degree of cochlear nerve function reserve. An excellent discussion of this phase of the subject was reported by Walsh and Silverman before the American Otological Society in 1946.

In 1938, 1940 and 1941, Lempert^{1,2,3} stated that fenestration was indicated only when the hearing for 512, 1,024 and 2,048 dv by bone conduction under ideal conditions had not receded to lower than the 30 db level; however, after operating on many patients whose minimum bone conduction findings were lacking and finding "in many the hearing loss was greatly diminished," Lempert,⁴ in November, 1941, no longer stated that fenestration is indicated when hearing by bone conduction has not receded to a level lower than 30 db for the critical frequencies, but stated instead that fenestration is indicated when the impairment of hearing in the 512, 1,024 and 2,048 frequencies is *not the result of degeneration of the cochlear nerve*.

If the presence and degree of bone conduction hearing are to be employed as an absolute barometer of the presence and degree of cochlear nerve function, a person with no bone conduction should be totally deaf; however, this is not always

the case, for, according to Lempert,⁵ one may have a total loss of hearing for bone conducted sound and yet hear the normally spoken voice by air conduction for a distance of one to five feet.

It is obvious that after considerable experience with functional testing, we do not have a sufficiently accurate device which is completely reliable in measuring bone conduction; furthermore, were we completely satisfied with the estimations obtained of bone conduction hearing, it would still be an assumption on our part that that estimation was consonant with the degree of cochlear nerve function. Clinically, it is the span or differential between bone and air conduction, in the critical frequencies, which we believe is the best index, thus far, of cochlear nerve function reserve. This, however, remains to be proven.

Lempert¹¹ has found the use of the ear trumpet of considerable value in aiding in establishing a measure of cochlear nerve function reserve. The patient is tested with eyes closed, one ear at a time, using a Bárány noise apparatus in the untested ear. If the patient hears a moderate voice at three feet, and with the use of the ear trumpet still hears at three feet, saying, "it is louder," but does not have increased intelligibility, this is interpreted as an indication of insufficient cochlear reserve function (nerve deafness). On the other hand, if the patient repeats words and sentences that were missed without the use of the ear trumpet and at a greater distance from the tested ear, this is interpreted as good cochlear reserve function in a patient with conduction impedance to the transmission of sound waves. For years, Meltzer¹² has utilized the speaking tube in testing patients with hearing impairments in order to distinguish between increased intelligibility in contradistinction to increased loudness.

Fig. 3 is that of a patient with clinical otosclerosis whom I first saw in 1943. This patient resisted operation at that time and on many subsequent occasions. The tuning fork tests and the audiometric findings are interesting. Tuning fork tests, family history, clinical course noted in 1943 were

indicative of otosclerosis. Curve A (taken in May, 1945) indicates good bone and air conduction in the critical frequencies as to make her an excellent case for operation. Curve B (taken in October, 1947) indicates falling off of both bone and air conduction curves. The patient was well aware that she was getting steadily worse.

The audiometric findings may be interpreted as indicating progressive loss with beginning nerve degeneration. In 1945,

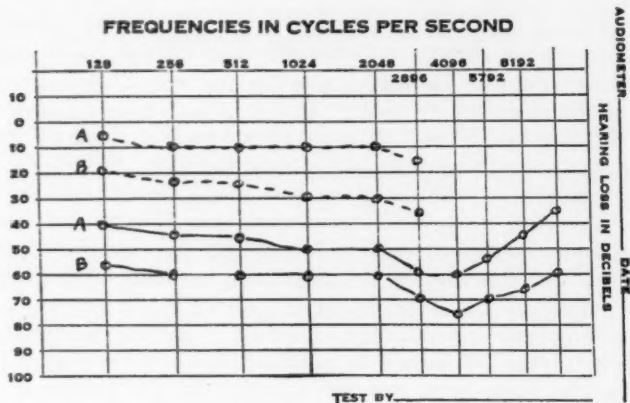


Fig. 3. Are the audiograms of a patient taken two years apart; Curve B in 1947. It shows a falling off by air and bone conduction with a span or differential for the critical frequencies diminishing as compared to Curve A.

this patient could justifiably have been regarded as an ideal case for fenestration operation, because she had a differential or span of 30 db between bone and air conduction for the critical frequencies, with bone conduction estimations not below the 30 db level. In 1947, however, she was no longer an ideal case but rather a beginning border line case, for she did not have the 30 db differential between air and bone conduction for the critical frequencies.

The likely outlook is for continued progressive loss of hearing. This patient, however, still has sufficient cochlear nerve function reserve, so that a well performed operation offers

hope for restoration of practical hearing. I consider this patient a border line case with a good prognosis.

It is well known that clinical otosclerosis frequently is characterized by a more fulminating course in the very young as compared to those of more advanced years. The extremely vascular bone of the inner tympanic wall has been noted during operation and may explain the progressive, malignant clinical course some of these cases of otosclerosis exhibit even after well performed fenestration operation.

At times, the question has been propounded, "Why not operate on clinical otosclerosis when the bone conduction is excellent and the air conduction loss for the critical frequencies is at the 20 to 25 db level?" If the patient then gains a 10 to 15 db improvement in the 512, 1,024 and 2,048 dv frequencies, he will approximate normal hearing. An answer to this was given at the recent meeting of the Otosclerosis Study Group, where it was postulated that patients with the above described findings usually have only partial fixation of the stapes, and, contrary to theoretical expectations, they would not gain 10 to 15 db increment of hearing and would not get an appreciable improvement. I would, therefore, paraphrase this by saying, patients with partial fixation of the stapes (if it can be diagnosed) are not suitable for the fenestration operation. Wever¹² attempted an explanation on the basis of phase differences in the transmission of sound waves, which differ if there is a new window made, in a patient with a *fixed* oval window and a movable round window membrane in contrast to the patient with a new window, a *partially fixed* oval window and a movable round window membrane.

CONCLUSION.

In an effort to determine the suitability of a case of clinical otosclerosis for fenestration, one is struck with certain inescapable impressions, the general one being that in a particular case the decision must be reached only after taking the *entire* clinical picture into consideration.

For purposes of discussion, I have divided the cases of oto-

sclerosis into three groups: 1. those in which there is no doubt as to their suitability, 2. those in which there is no doubt as to their unsuitability, 3. those in which there is considerable doubt in deciding whether or not they are suitable for fenestration. For want of a better term, this group has been referred to as the "border line" group.

An accurate, infallible test has not yet been developed for the estimation of reserve cochlear nerve function in clinical otosclerosis to aid one in making a decision in the so-called "border line" cases. The significance of the interpretation of the audiogram has been discussed.

BIBLIOGRAPHY.

1. LEMPERT, J.: Improvement of Hearing in Cases of Otosclerosis. *Arch. Otolaryngol.*, 28:42-97, July, 1938.
2. LEMPERT, J.: Endaural Fenestration of External Semicircular Canal for Restoration of Hearing in Cases of Otosclerosis. *Arch. Otolaryngol.*, 31:711-779, May, 1940.
3. LEMPERT, J.: Endaural Fenestration of Horizontal Semicircular Canal for Otosclerosis, Indications, Technique, Observations as to Early and Late Postoperative Results. *THE LARYNGOSCOPE*, 51:330, Apr., 1941.
4. LEMPERT, J.: Fenestra Nov-Ovals: A New Oval Window for the Improvement of Hearing in Cases of Otosclerosis. *Arch. Otolaryngol.*, 34: 880-912, Nov., 1941.
5. LEMPERT, J.: Lempert Fenestra Nov-Ovals with Mobile Stopple. *Arch. Otolaryngol.*, 41:1-41, Jan., 1945.
6. MOOREHEAD, R.: Fenestration in Otosclerosis. *Trans. Am. Laryngol., Rhinol. and Otol. Soc.*, 1946, pp. 169-182.
7. HOUSE, H. P.: Indications for the Fenestration Operation. *Trans. Am. Laryngol., Rhinol. and Otol. Soc.*, 1946, pp. 305-313.
8. WILLIAMS, H. P.: Discussion of Paper of Dr. L. Spake. *Trans. Am. Laryngol., Rhinol. and Otol. Soc.*, 1946, p. 302.
9. MAXWELL, J. H.: Training of Surgeon and Selection of Patients for Fenestration. *Arch. Otolaryngol.*, 46:539-543, Oct., 1947.
10. DAY, K. M.: Medical and Surgical Case of Patient Selected for Fenestration of Labyrinth. *Arch. Otolaryngol.*, 46:534-538, Oct., 1947.
11. LEMPERT, J.: Personal communication, Dec., 1947.
12. WEVER, E. G.: Discussion at Otosclerosis Study Group, Chicago, Oct., 1947.
13. MELTZER, PHILIP: Personal communication, 1947.
14. WALSH, T. E., and SILVERMAN, S. R.: Diagnosis and Evaluation of Fenestration. *THE LARYNGOSCOPE*, 56:536:555, Sept., 1946.

THOMAS WHARTON,
1614-1673.

First Gland Specialist and Discoverer of a Salivary Duct.

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The sixteenth century is marked medically by the occurrence of a stirring revival of the science of human anatomy.

As soon as it was discovered that Galen, until then an undisputed authority, had made certain mistakes in his description of the structures of the body, it was inferred that he might also have made other mistakes; so research in this direction was prosecuted with great zeal and engaged the attention of men of extraordinary talent, such as Vesalius, Fallopius, Eustachius, Columbus, Servetus, Vidijs and Variolus.

The result established not only a more correct but also a more extended anatomy.

With the turn of the century there was a new turn in the nature of anatomical investigation. It took on the form of a specialized study of the organs or systems of the body economy, always with an eye to the functions of the parts under investigation.

One of the first and most notable of such studies was that made of the cardiovascular system by Harvey, resulting in the discovery of the circulation.

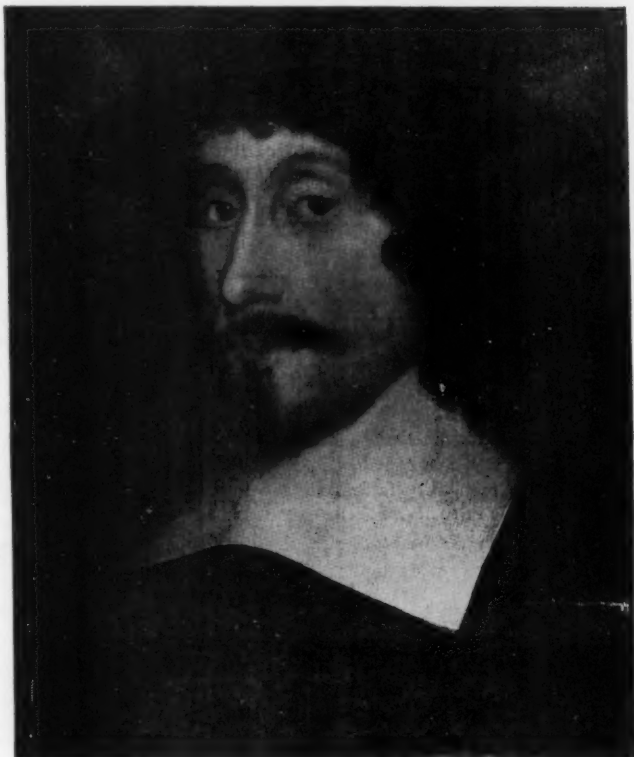
His famous "De Motu Cordis" was published in 1628, but he had lectured on the subject as much as 12 years earlier.

Specialized researches, each of historic value, followed in quick succession.

The lacteals were discovered by Aselli in 1622; the pancreatic duct by Wirsung in 1642. Then followed shortly after intensive studies on the lacteals and lymphatics and their uses by Pecquet (1651), and Rudbeck (1653).

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, March 1, 1948.

The maxillary antrum was discovered by Highmore in 1651, the classic work on anatomy of the liver by Glisson appeared in 1654, and Schneider's illuminating treatise on anatomy and physiology of the nasal membranes in 1660.



Wharton, in 1656, published his treatise on glands, in which was recorded the first discovery of a salivary duct (Wharton's duct).

Then followed discovery of the other salivary ducts, in

each case the duct taking on the name of the discoverer — the parotid by Stensen (1662), and the large sublingual by Caspar Bartholin (1684), and finally the ducts of the other sublinguals by Rivinius.

The name of Wharton is kept forever green in medical literature by two well known eponyms: *Wharton's Duct*, the duct of the submaxillary salivary gland, is a canal about 4 cm. long and about one-third the size of that of the parotid. It leaves the anterior part of the gland and runs along the floor of the mouth to open at the base of the frenum of the tongue. It sometimes opens in connection with the duct of Bartholin, being then known as *ductus communis*, or common duct.

Wharton's Jelly is the name applied to the soft, pulpy, jelly-like connective tissue that constitutes the basic substance of the umbilical cord.

Wharton, in his description, refers to the little dilation which appears at intervals and which, according to Glisson, midwives in that day made use of to predict the number of offspring to be expected.

Wharton's research studies were carried on at a time of great political turmoil and strife leading to a civil war lasting 12 years and involving the whole nation. One naturally thinks of such conditions as very unsuited to a high character productiveness either in science or literature. Strangely enough, however, seldom have greater heights ever been reached in either. For was it not the era of the sublime poetry of Milton, and of the revolutionary discovery of Harvey?

Besides "Paradise Lost," English literature was enriched by such productions as Bunyan's "Pilgrim's Progress," Sir Thomas Browne's "Religio Medici," Isaak Walton's "Compleat Angler," Samuel Butler's "Hudibras," and the poetry of Dryden, Herrick, Lovelace and Waller.

Medical men managed to continue their studies. Besides Harvey, the medical profession was represented in this era by Thomas Sydenham, the so-called English Hippocrates, who re-established the practice of medicine on the sensible basis

of observation and experience; and Thomas Willis, who championed chemical therapy and whose name is perpetuated by two eponyms,—the circle of Willis, well known in the anatomy of the brain, and the paracismus Willisii, well known in the specialty of otology.

Sydenham and Willis were on opposite sides during the civil war, and both saw actual military, that is, nonmedical, service.

Sydenham was Captain of Horse in the Parliamentary Forces during the siege of Oxford. Willis joined the Garrison and bore arms in the defense of the King.

Another great medical man of that era was Francis Glisson, who attained fame as an anatomist, a clinician and as a philosopher: in anatomy, by his treatise on the structure of the liver, and the discovery of the capsule which bears his name; in clinical medicine, by his original classic description of rickets; in philosophy, by his theory of the "irritability" of all living tissue.

Medical research went on bravely at Oxford in the face of the storm and stress of the general political turmoil. Here Willis pursued his study of the anatomy of the brain, and here Richard Lower made the first experiment on record in the transfusion of blood.

Associated with these were two students of medicine who later became famous in other walks of life. One, Christopher Wren, assisted Willis in making anatomical drawings, and assisted Lower by devising an instrument for making transfusions, and on his account made experiments of injecting drugs into the veins of animals. In later years he became the renowned architect of St. Paul's Cathedral and many other great buildings erected after the London fire.

The other, John Locke, gave up medicine for philosophy. His "Essay Concerning the Human Understanding" won for him a high place among the philosophers of the world.

Thomas Wharton was born Aug. 31, 1614, at Winston-on-Tees, Durham, being the son of John and his wife Elizabeth

(Hodson). He came of an old and well-established family; the father had the means and the desire to have his son receive a good education.

When Thomas was 11 years of age, Charles I had just become king. His boyhood and youth were, therefore, passed in a period of continuous civil political and religious unrest. The king commenced his reign by acts of arbitrary and despotic rule which enraged the people. Parliament is summoned to authorize expenditures for running the government and making war. Instead of doing so, they pass measures to limit the power of the throne.

In his youth, Wharton must have heard much of Hampden, and Pym and Eliot, eloquent orators and fearless champions of the people's cause.

Parliament is dissolved by royal edict, and then follows a period of terror and gloom in all England.

It is a period of illegal taxation, forced loans, star-chamber proceedings, religious persecutions with arrest and imprisonment in case of resistance. In 1638, the year in which the patriot Hampden was tried and condemned, Wharton enrolled as a student at Cambridge University. A year or so later, however, for some reason, he left Cambridge and entered Trinity College, Oxford.

While at Oxford he did double duty, being both student and teacher. While pursuing his medical studies, he served at the same time as a tutor to young John Scrope, a son of Lord Scrope.

At the outbreak of the civil war the King, finding London an unsafe place, moved with his court to Oxford.

We mentioned the fact that when the town was besieged by the Parliamentary Army, two great medical men, Sydenham and Willis, fought on opposite sides.

We have no information as to whether Wharton at any time took an active part in the war. We are informed that at the outbreak he left Oxford for the town of Bolton, about 50

or more miles away. As this town was a stronghold of the Parliamentary Forces, it is reasonable to infer that his sympathies were with this party. This inference is strengthened by the fact that three years later he moved to London and began to practice medicine there, in association with Dr. John Bathurst, who became one of Cromwell's physicians; furthermore, shortly after Oxford fell to the Parliamentary forces, we find Wharton returning to Oxford (1647) to receive his degree of M.D., on the recommendation of Lord Fairfax, Cromwell's Commander-in-chief.

Because of troubled conditions, the conferring of degrees was often delayed in this way, and one might practice medicine and not get his degree until some years later. Lord Fairfax was a man of literary tastes and a patron of learning, and of the universities. He joined the Parliamentary side because he was opposed to the very arbitrary policy of Charles I, the king. In the early stages of the political difficulties he endeavored to personally present a petition to the king to listen to the voice of parliament. When Charles evaded receiving the petition, he placed it on the pommel of his saddle.

The king persisted in his blind and unreasonably obstinate course, and was brought to trial and executed in the year 1649.

Cromwell, in 1653, with a disregard of law and order, beyond even that which he had condemned, abolished parliament by force of arms, and from that time to his death, he ruled England with an iron hand.

In the meantime, Wharton was rising in the world of medicine. In 1650, he became a Fellow of the Royal College of Physicians, in 1652 he received an honorary degree at Cambridge.

His "Adenographia," published in London in 1656, immediately received great attention from medical men all over Europe. A new edition appeared in Amsterdam in 1659, followed by several other editions in other centers of learning (Amsterdam, 1659; Oberwesel, 1664, 1671, 1675; Dusseldorf, 1730).

In 1658, he was chosen for the high honor of censor in the Royal College of Physicians, and he was re-elected each year for the succeeding five or six years.

In 1660, the monarchy was restored and with Charles II setting the example, London became a city of unrestrained gaiety, luxurious living and a generally low standard of morals; but this kind of life was soon to receive a serious check.

In the fall of 1669, the deadly plague began to creep in, and by spring the following year spread so fast as to turn all London into a city of sickness, misery and despair. Of a population of less than 500,000, 90,000 were stricken and died. Those who were able left their homes and fled to the country. The lot of those who had to remain was unbelievably miserable, for they were left sick and dying, with no one to care for them.

With the idea of preventing the spread of the contagion, infected houses were shut up, condemning the inmates to almost certain death. The outside of such houses was marked with a red cross, and the legend, "God Have Mercy on Us."

At the height of the pestilence, deaths were so numerous that funeral ceremonies had to be dispense with. In the middle of the night, wagons were sent through the streets by the authorities, and in passing along the driver rang a bell and called out, "Bring out your dead."

Physicians who refused to leave the city, but remained to do the best they could for these poor, helpless souls, deserve to be remembered. Dr. Wharton was such a one. He was promised recognition for this sacrifice. The king, or someone near him, told him that he would surely be made one of the physicians to the crown; but when all was over, the promise was forgotten. All he received was an augmentation of his coat of arms, and for this he had to pay out of his own pocket.

Very little seems to be known of the personal life of Wharton. In the comprehensive catalogue of the Army Medical Library we could find but two brief biographical sketches of this man whose name is frequently on the lips of every student

and practitioner of medicine, while in the same catalogue you will find references to dozens of biographies of his contemporary, Willis, hundreds to his contemporary, Sydenham.

The fact that he was an Oxford man won him some notice in a rare old book, a copy of which is to be found in the Library of Congress, Anthony à Wood's "Athenae Oxiensis."

Wood, in his quaint chronicle, includes personal notes not elsewhere to be found. We have mentioned that Wharton, while at Oxford, tutored a certain nobleman's son, named John Scrope. Wood tells us that the latter was "the natural son of the Earl of Sutherland, whom he begat on the body of his servant maid, named Martha Jeanes, daughter of John Jeanes, a taylor living sometime in the parish of Turfield near to Wycomb in Bucks. . . ."

"After the Oxford garrison was surrendered for the use of parliament in 1646," he tells us, "Wharton returned to Trinity College again, and as a member thereof was actually created doctor of physic in the beginning of the year 1647, by virtue of the letters of Sir Thomas Fairfax, generallissimo of the parliamentary army."

It is interesting to read his contemporary estimate of Wharton's "Adenographia":

"In which book he has given a more accurate description of the glands of the whole body than was formerly done. And whereas authors have subscribed to their very mean uses (as supporting the division of vessels, or imbibing the superfluous humidities of the body) he assigns them more noble and considerable uses, as the preparation and depuration of the *succus nutritius*, with several other uses besides to different glands as well as for conservation of the individual, as propagation of the species."

"What else he hath written I find not, nor anything besides of him — only that he is dying in his house at Aldersgate in the month of October 1673."

Lacking direct information as to the personal life of Whar-

ton, it might not be amiss to include a word or two as to some of his known friends, on the principle "that by your *friends* ye may know them."

The man whose name is especially linked with his is Francis Glisson, whom we already referred to as one of the great doctors of this era.

These two men were enthusiastic admirers, each of the other's work. Wharton named Glisson in the dedication of his "Adenographia," and the latter included much of the matter in his own publication and made many favorable comments.

Besides being a doctor, Glisson was a profound student of philosophy. He was one of the founders of the Royal Society, and for 40 years Regius Professor of physic at Cambridge.

Glisson, like Wharton, remained at his post to look after the sick during the great London plague. It is certainly to the credit of the latter to have had as one of his best friends a man of such high merit and character.

The name of Dr. John Bathurst is joined with that of Glisson in the dedication of the "Adenographia."

Bathurst was, like Wharton, a Yorkshire man who went to the University of Cambridge. He was but a few years older, but he received his degree at the beginning of the war and was established in practice in London for some years when Wharton decided to go there to become his assistant. That the two were associated as friends and companions as well as in medical work might be inferred by their names being linked together by that ubiquitous chronicler of the era, John Aubrey.

He was writing about Dr. John Dee, a famous alchemist, and of the rumors that he had been actually successful in creating gold out of basic metal by "projection," as it was called.

In confirmation of the story, Aubrey remarks that Dr. Dee's son told Dr. Bathurst and Dr. Wharton that he had actually seen, in his father's garret, strips of gold that had been so produced.

There is evidence that Dr. Bathurst had a good deal of influence with his distinguished patient, the Lord Protector.

One of the prisoners taken at the battle of Worcester was Sir Richard Fanshaw, a zealous royalist who had served as War Secretary to Charles at Oxford. He had been a patient of Dr. Bathurst and the latter pleaded with Cromwell for his release from prison on the ground of ill health. Strangely enough, the request was granted in the face of powerful opposition.

Cromwell suffered considerable ill health during the last seven or eight years of his life. As early as 1651, following the battle of Dunbar, he wrote to his wife, "I assure thee I grow an old man and feel the infirmities of age marvellously steeling upon me."

He suffered repeated severe attacks of malaria fever which he is supposed to have first acquired by much exposure during the trying campaign in Ireland. He is reported to have been a sufferer also from gout and kidney stone. He was probably a recalcitrant patient, as he apparently believed more in the efficacy of prayer than of medicine.

During his last illness, when he was *in extremis* and the doctors probably showed their uneasiness by their expression, he told them they need not look so downcast as he had no intention of dying at that time. "Don't think I am mad," he said, "I speak this word on surer ground than Galen or your Hippocrates."

Dr. Bates, who attended him in this last illness, has left us a record of the autopsy, but written as it is in the obsolete phraseology of Galenic medicine it has but little meaning for us today.

"His body being opened in the animal parts, the vessels of the brain seemed to be overcharged; in the vitals of the lung a little inflamed, but in the naturals the source of the distemper appeared; the spleen though sound to the eye being filled with matter resembling the lees of oil."

Then follows a statement which, if well considered, throws

doubt upon the story which all historians repeat, namely, that shortly after the Restoration his body was taken from the tomb, dragged through the streets and tied up to public lamp post to receive the execrations of the mob.

Dr. Bates reports, "Though his bowels were taken out and his body filled out with spices and wrapped in sixfold cerecloth and put first in a leather coffin and then into a strong wooden one, yet the corruption burst through all and the foul smell pervading the house, it was necessary to inter the body before the solemnities of the funeral."

It is known that a wax effigy, royally accoutered, was prepared for the ceremony of lying in state and the public funeral.

What was done with the body itself is still a mystery.

According to one witness, it was thrown into the Thames, according to another it was buried in accordance with Cromwell's own request on the battle field of Naseby. Either version might be true, for it is very unlikely that his family or friends would, under the circumstances, accede to a public funeral.

Dr. Bathurst was a man of prominence as a citizen as well as a physician. In 1656, the year in which "Adenographia" was published, he served as a member of Parliament, representing the city of Richmond in Yorkshire; in 1657, he was chosen an "elect" of the College of Surgeons, in place of the great Harvey, who declined the honor. Notwithstanding their positions as physicians to the opposing leaders in the strife, they were friends.

Another person who has been mentioned as a friend of Wharton was Elias Ashmole, the celebrated antiquarian. Ashmole was a very learned man, but much given to the study of alchemy and astrology (Wharton contributed some verses for one of his books on alchemy). We do not know whether or not this signifies that he was interested in that subject, as were many of his era.

We are told by Wood that the two men quarreled and that

Ashmole complained that he had been badly treated by Wharton; however, they became reconciled in later life. Ashmole received an honorary M.D. degree from Oxford.

It is with pleasure we record Wharton's friendship with one of the great and most beloved personages of that era, Isaak Walton. Walton expresses his indebtedness to Wharton in the preparation of a certain part of his "Compleat Angler," namely, that which deals with the history and the philosophy of his subject. "Dr. Wharton," he says, "is a dear friend who loves me and my art of fishing." This friendship is better than any other kind of testimony to Wharton's character, for, as Isaak Walton himself once wrote, "Good friends and good discourse are the very sinews of virtue."

Wharton was a man of broad culture and learning not confined to medicine. He was a student of philosophy and we have noted wrote a little poetry. His reputation as a medical man rests upon his one work, entitled "*Adenographia sive glandularum totius corporis descriptio*."

It is the first treatise to appear devoted to the discussion of the glands of the body, and as it was not confined to anatomy but considers physiology, pathology and treatment, it entitles the author the honor of being regarded as the first gland specialist. It takes in, also, many related subjects. It is here that we find the original description of the so-called Wharton jelly.

Much of the matter sounds a little queer to us today with its consideration of "animal spirits" and of "nervous juice" and of its "sanguineous" and "spermatic" tissues. It was, however, an advance of the times and as emphasis was placed on direct observation rather than authority, it aroused much interest and had a generally stimulating effect.

His discovery of the first salivary duct was of special value to Sylvius and others who were at the time greatly interested in the study of the processes of digestion.

He described better than had been done before the thyroid and the pancreas, and aside from his idea of the essential

part played by the nerves, he seems to have foreshadowed in a way modern ideas of endocrine functions.

Boerhaave, the most famous medical man of the following century, spoke of Wharton as a "most eminent investigator of anatomy, of the greatest authority in that science; a man of integrity and of the highest report, not a great reasoner but one who relied exclusively on the dissecting knife."

After the Restoration, Wharton continued to live in London, where he built up a very extensive and successful practice. He married Jane, the daughter of William Aldridge, of that city.

His death occurred Nov. 15, 1673, and he was buried in the Church of St. Michael's, in Bassinghall Street. His wife predeceased him and he left three sons, two of whom died young. The other, Thomas, became a physician. This Thomas had one son, George, who also took up medicine and attained considerable prominence. He followed in his grandfather's footsteps in that, having studied at Cambridge, where he received his M.D., he became a member and later a censor of the Royal College of Physicians.

He presented to the college a painting of his grandfather, a copy of which is here reproduced.

AN INSTRUMENT FOR THE REMOVAL OF CHOANAL POLYPS.

HARRY NEIVERT, M.D., and LEO A. KALLEN, M.D.,
New York, N. Y.

Safety, simplicity, speed and absence of trauma justify reporting a method for removing the so-called "choanal" polyp. Such a structure usually originates as a simple antral polyp. Rarely, it may arise from the sphenoidal sinus or from a posterior ethmoidal cell. It never arises from the cribriform area or olfactory fissure. When it springs from the antrum it is gradually pushed out by its growth into the middle meatus, usually through an accessory ostium. Anatomic conditions then direct it backwards and downwards into the postnasal space. Thus it comes to assume a more or less pyriform shape whose stem lies hidden in the middle meatus and whose broad end presents in the nasopharynx. The latter is often seen in the postnasal mirror as a rounded grayish-blue or whitish mass. The hidden stalk can occasionally be brought into partial view on anterior inspection after shrinking the nasal mucosa. We have observed this type of polyp in children and adults alike.

Everyone experienced with the usual procedure for the removal of such a structure (wire snare and/or biting forceps) knows how difficult and often inadequate it can be. Many times it is impossible to encompass the mass with a wire loop, even though the latter may find easy enough access into the nasal cavity. This circumstance led Sir St. Clair Thomson to recommend as an aid toward this end the introduction of the left forefinger into the postnasal space from behind. When certain types of septal or other intranasal deformities are present, however, this does not help. Even under conditions that make it feasible, the procedure is both awkward and hard on the patient.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, Jan. 23, 1948.

With these considerations in mind, the authors apply an instrument designed to overcome the physical obstacles that render use of the snare impractical and obsolete.



Fig. 1. The Neivert choanal polyp hook.

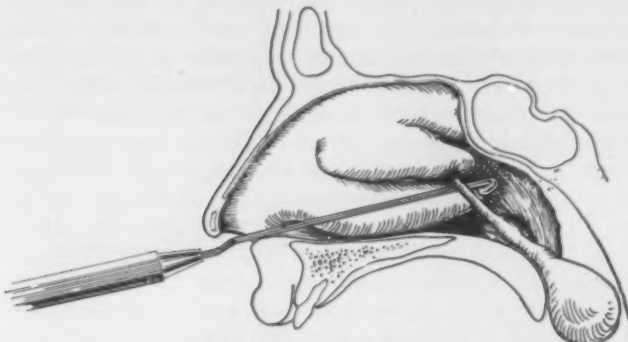


Fig. 2. Insertion of hook.

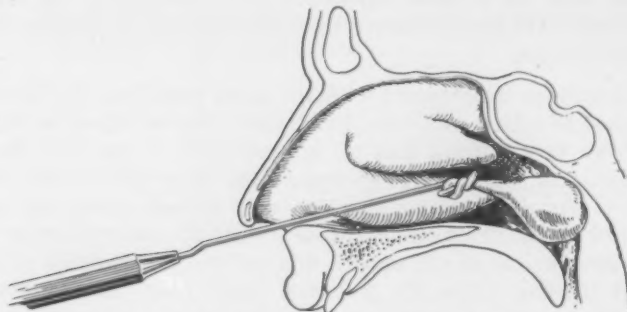


Fig. 3. Engagement and rolling of stalk.

The instrument is a hook, $7\frac{1}{2}$ inches long, a one-quarter-inch hexagonal handle constituting its lower half. The upper half is a semirigid No. 14 gauge phosphor-bronze or stainless steel wire whose tip is bent into an almost complete irregular curve.

The dimensions of angle and curve are calculated to cause minimal trauma.

The technique is very simple. The nasal cavity is sprayed with 2 per cent cocaine or its equivalent. The instrument is introduced and, hugging the lateral nasal wall, is passed as far back as possible beyond the end of the middle meatus. It

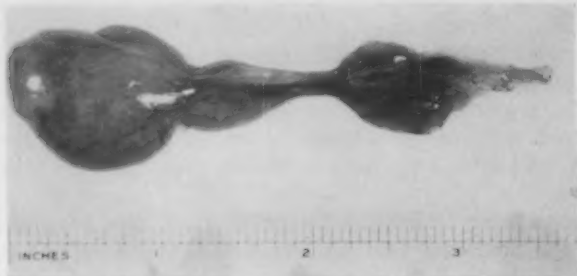


Fig. 4. Photo of four-inch polyp, half of which was intra-antral. (Operation at Vanderbilt Clinic, Presbyterian Hospital, Dec. 5, 1932, Mrs. G.)

is then given a half turn directing the hook toward the septum. In this position it is slowly brought forward until resistance caused by the hook's engagement of the stalk is felt. The handle is then given a few rapid turns which rolls up the stalk on the hook. Extraction is then executed by a deft quick stroke. In cases where the polyp is too large to pass through the nasal passage, or where the latter is too narrow to permit it, removal is accomplished by having the patient bend his head forward, hawk back and expel the polyp through the mouth after withdrawal of the instrument. At times it may be necessary to pass the instrument along the septum and rotate the hook toward the lateral wall of the nose in order to engage the stalk.

The whole procedure requires but a few seconds. Children hardly mind it. More of the stalk is obtained than by any other method; in fact, the intra-antral attachment of the pedicle is often extracted with it, as the accompanying photograph shows.

555 Park Avenue.

INTERNATIONAL SURGICAL ASSEMBLY.

The Sixth International Assembly of the International College of Surgeons will be held in Rome, Italy, at the invitation of the Italian Government, during the week of May 16-23, 1948, under the presidency of Prof. Raffaele Bastianelli and Prof. Raffaele Paolucci, of Rome, and Prof. Mario Dogliotti, of Turin. The secretary of the Assembly is Prof. Giuseppe Bendandi, of Rome. Attendance is not limited to the membership of the College; all surgeons in good standing in their medical organizations are invited. Scientific meetings, scientific and commercial exhibits, visits to the Universities of Turin and Milan have been arranged, together with tours to other medical centers in Europe. A special exhibit of ancient texts on surgery is being arranged by Prof. Davide Giordano, of Venice, honorary president, under the active presidency of Prof. Adalberto Pazzini, professor of history at the University of Rome. This extraordinary exhibit dealing with ancient surgery will be on display in the Vallicelliana Library in one of the historical buildings of the Vatican. Detailed information may be obtained from Dr. Max Thorek, General Secretary, 850 Irving Park Road, Chicago 13. For travel information, address the All Nations Travel Bureau, 38 South Dearborn Street, Chicago, the official travel representatives for this Assembly. Those desiring to present scientific papers, address Dr. Karl Meyer, Cook County Hospital, Chicago; Dr. Henry W. Meyerding, Mayo Foundation, Rochester, Minn., or Dr. Herbert Acuff, Acuff Clinic, 514 West Church Street, Knoxville, Tenn. Those from Canada should direct their inquiries to Dr. Lyon Appleby, 925 W. Georgia Street, Vancouver, B. C.

AMERICAN BRONCHO-ESOPHAGOLOGICAL ASSOCIATION.

The Twenty-ninth Annual Meeting of the American Broncho-Esophagological Association was held in Atlantic City at the Chalfonte-Haddon Hall on the afternoons of April 7 and 8, 1948. The program follows:

Bronchial Adenomas—Dr. Louis H. Clerf, Philadelphia, Pa.

Fibrocystic Disease of the Pancreas, and Its Relation to Pulmonary Suppuration—Dr. Joseph P. Atkins, Philadelphia, Pa.

Bronchoscopic Examinations in the Newborn — Dr. Clyde Heatly, Rochester, N. Y.

Tracheal and Bronchial Obstruction Due to Cardiovascular Anomalies—Dr. Paul H. Holinger, Chicago, Ill.

Bronchospirography—Dr. Charles Norris, Philadelphia, Pa.

Histal Hernia of the Esophagus—Dr. F. Johnson Putney, Philadelphia, Pa.

Syphilitic Tumor of the Bronchus—Dr. Archibald R. Judd, Hamberg, Pa.

The Present Status of Broncho-Esophagology in Latin America—Dr. C. L. Jackson, Philadelphia, Pa.

Reconstruction Surgery of the Trachea—Dr. Longmire, Baltimore, Md.

Streptomycin Therapy in Tracheal and Bronchial Tuberculosis—Dr. John J. O'Keefe, Philadelphia, Pa.

Rhinoscleroma of the Bronchus—Dr. Ricardo Tapia, Mexico City, Mexico.

Allergic Manifestations of Pulmonary Disease—Dr. Francis W. Davison, Geisinger Memorial Hospital, Danville, Pa.

Hemoptysis Due to Chronic Mediastinal Venous Obstruction—Dr. Stanton A. Friedberg, Chicago, Ill.

Granuloma of the Larynx Due to Intratracheal Anesthesia—Dr. Frederick T. Hill, Waterville, Me.

THE LOUISIANA-MISSISSIPPI OPHTHALMOLOGICAL
AND OTOLARYNGOLOGICAL SOCIETY.

The Annual Meeting of the Louisiana-Mississippi Ophthalmological and Otolaryngological Society will be held at the St. Charles Hotel in New Orleans, La., on Saturday, April 17, 1948.

PROGRAM.

- 8:30 A.M. Registration
- 9:00 Call to Order
Preliminary Announcements
Appointment of Committees
President's Address: Dr. Noel T. Simmonds,
Alexandria, La.
"Sectional Obstruction and Bulbar Poliomyelitis," Dr. Thos. C. Galloway, Evanston, Ill.
"The Preparation of Patients for Intraocular Surgery," Dr. Walter Stevenson, Quincy, Ill.
- 12:30 P.M. Luncheon
Executive Session
- 2:00 "The Management of Complications of Ocular Surgery," Dr. Watson Gailey, Bloomington, Ill.
The J. Raymond Hume Memorial Address —
"Vertigo: Differential Diagnosis and Treatment," Dr. J. R. Lindsay, Chicago, Ill.
- 5:30 Cocktail Party for Fellows, Guests and their Ladies

The registration fee of \$10.00 includes the luncheon and the cocktail party.

For further details, address Dr. Edley H. Jones, Secretary, 1301 Washington Street, Vicksburg, Miss.

FEB. 26, 1948.

**HEARING AIDS ACCEPTED BY THE COUNCIL ON
PHYSICAL MEDICINE OF THE
AMERICAN MEDICAL ASSOCIATION.**

Aurex (Semi-Portable) ; Aurex Model C-B, Model C-A, Model F and Model H.

Manufacturer: Aurex Corp., 1117 N. Franklin St., Chicago, Ill.

Beltone Mono-Pac; Beltone Harmony Mono-Pac.

Manufacturer: Beltone Hearing Aid Co., 1450 W. 19th St., Chicago, Ill.

Electroear Model C.

Manufacturer: American Earphone Co., Inc., 10 East 43rd St., New York 17, N. Y.

Maico Type K; Maico Atomeer.

Manufacturer: Maico Co., Inc., North Third St., Minneapolis, Minn.

Mears Aurophone Model 98.

Manufacturer: Mears Radio Hearing Device Corp., 1 W. 34th St., New York, N. Y.

Microtone T-4 Audiomatic.

Manufacturer: The Microtone Co., 4602 Nicollet Ave., Minneapolis, Minn.

**Otarion Model A-1; Otarion Model A-2; Otarion Model A-3;
Otarion Models A-4 J and D; Otarion Model E-1.**

Manufacturer: Otarion Hearing Aids, 448 N. Wells St., Chicago, Ill.

**Paravox Models VV2 and VV3; Paravox Models VH and VL;
Paravox Model XT; Paravox Model XTS.**

Manufacturer: Paraphone Hearing Aid, Inc., 2056 E. 4th St., Cleveland, Ohio.

Radioear Masterpiece; Radioear 45-CM; Radioear Model 45-M-magnetic air conduction receiver; Radioear Model 45-M-magnetic bone conduction receiver.

Manufacturer: E. A. Myers & Sons, 306 Beverly Rd., Mt. Lebanon, Pittsburgh, Pa.

Ravox (Semi-Portable).

Manufacturer: Zenith Radio Corp., 6001 W. Dickens Ave., Chicago, Ill.

Silver Micronic Hearing Aid.

Manufacturer: Micronic Corp., 101 Tremont St., Boston 8, Mass.

Solopak Hearing Aids.

Manufacturer: Allen-Howe Electronics Corp., 150 Main St., Peabody, Mass.

Sonotone Audicles No. 530, No. 531 and No. 533; Sonotone Model 600; Sonotone Model 700.

Manufacturer: Sonotone Corp., Elmsford, N. Y.

Telex Model 22; Telex Model 612; Telex Model 900; Telex Model 1020; Telex Model 1550.

Manufacturer: Telex, Inc., Minneapolis 1, Minn.

Trimm Vacuum Tube No. 300.

Manufacturer: Trimm, Inc., 400 W. Lake St., Libertyville, Ill.

Unex Model "A."

Manufacturer: Nichols & Clark, Hathorne, Mass.

Vacolite Model D.

Manufacturer: Vacolite Co., 3003 N. Henderson, Dallas, Tex.

Vactuphone Hearing Aid.

Manufacturer: Allen-Howe Electronics Corp., 150 Main St., Peabody, Mass.

Western Electric Audiophone Ortho-technic Model; Western Electric Telephone Type Audiophone Model J-1; Western Electric Model 63; Western Electric Model 64; Western Electric Models 6S and U.

Manufacturer: Western Electric Co., Inc., 300 Central Ave., Kearny, N. J.

Zenith Radionic Model A-2-A; Zenith Radionic Model A-3-A; Zenith Radionic Model B-3-A; Zenith Model 75.

Manufacturer: Zenith Radio Corp., 6001 Dickens Ave., Chicago, Ill.

**UNIVERSITY OF MINNESOTA COURSE
IN OTOLARYNGOLOGY.**

The University of Minnesota announces the sixth biennial Continuation Course in Otolaryngology to be held June 28, 29, 30, July 1 and 2. This course is designed to bring to the practicing otolaryngologist the newer concepts and developments in the specialty. The course will be under the direction of Dr. Lawrence Boies and associates of the university medical school. Dr. Harold I. Lillie, Dr. Gordon B. New and others of the graduate school faculty will participate in the instruction. Guest lecturers will include Dr. Kenneth Day, Pittsburgh; Dr. Gordon Hoople, Syracuse; Dr. C. Stewart Nash, Rochester, N. Y., and Dr. Francis LeJeune, New Orleans.

The fee for this course is \$35.00. The enrollment is limited. Application should be made at an early date to the Director, Center for Continuation Study, University of Minnesota, Minneapolis 14, Minn.

DIRECTORY OF NATIONAL OTOLARYNGOLOGIC SOCIETIES.

AMERICAN OTOLOGICAL SOCIETY.

President: Dr. Bernard J. McMahon, 806 Missouri Theatre Bldg., St. Louis 3, Mo.
Secretary: Dr. Gordon D. Hoople, Medical Arts Bldg., Syracuse 3, N. Y.
Meeting: Hot Springs, Va., The Homestead, April 12-13, 1948.

AMERICAN LARYNGOLOGICAL ASSOCIATION.

President: Dr. Arthur W. Proetz, Beaumont Bldg., St. Louis 8, Mo.
Secretary: Louis H. Clerf, 1530 Locust St., Philadelphia 2, Pa.
Meeting: Hot Springs, Va., The Homestead, April 14-15, 1948.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President: Dr. Lyman G. Richards, 15 Whiting Road, Wellesley Hills, Mass.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Building, Rochester, N. Y.
Meeting: Atlantic City, N. J., Chalfonte-Haddon Hall, April 7-9, 1948.

AMERICAN MEDICAL ASSOCIATION, SECTION ON LARYNGOLOGY, OTOTOLOGY AND RHINOLOGY.

Chairman: Dr. Fletcher D. Woodward, 104 E. Market St., Charlottesville, Va.
Secretary: Dr. James M. Robb, 641 David Whitney Bldg., Detroit, Mich.
Meeting: Chicago, Ill., June 21-25, 1948.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. Carl H. McCaskey, 608 Title Guaranty Bldg., Indianapolis 4, Ind.
President-Elect: Dr. Conrad Berens, 35 E. 70th St., New York, N. Y.
Executive Secretary: Dr. William L. Benedict, Mayo Clinic, Rochester, Minn.
Meeting: Chicago, Ill., Palmer House, Oct. 10-15, 1948.

AMERICAN SOCIETY OF OPHTHALMOLOGIC AND OTOLARYNGOLOGIC ALLERGY

President: Dr. W. Byron Black, 530 Professional Bldg., Kansas City, Mo.
Secretary-Treasurer: Dr. Francis L. McGannon, 14900 Detroit Ave., Lakewood, Ohio.
Meeting: Chicago, Ill., Palmer House, Oct. 8-9, 1948.





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For further information address

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